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THE

A B C

OF

MODERN PHOTOGRAPHY.

COMPRISING

PRACTICAL INSTRUCTIONS IN WORKING GELATINE
DRY PLATES.

BY W. K. BURTON, C.E.

THIRD, AND ENLARGED EDITION.

LONDON:

PIPER & CARTER, 5, CASTLE STREET, HOLBORN, E.C.


1883.

P. MEAGHER,

PHOTOGRAPHIC APPARATUS MANUFACTURER

DRY PLATE CAMERAS, ETC.

No. 1.— $4\frac{1}{4}$ by $3\frac{1}{4}$ Improved Pocket Camera, folding bottom, rack adjustment, 2 double backs, Ross' No. 2 Portable Symmetrical Lens, complete in leather case, with tripod stand		£10	1	0
If fitted with Dallmeyer's 5 by 4 Rapid Rectilinear Lens in place of Ross' Symmetrical Lens		...	11	6
No. 2.—5 by 4 Improved Pocket Camera, as above, fitted with Ross' 5 by 4 Rapid Symmetrical Lens, leather case, and stand		...	11	13
If fitted with Dallmeyer's 5 by 4 Rapid Rectilinear Lens		...	11	18
No. 3.— $6\frac{1}{2}$ by $4\frac{3}{4}$ Improved Portable Bellows Camera, single swing back, with 3 double backs, fitted with Ross' Rapid Symmetrical Lens, including leather case and tripod stand		...	14	11
Do., fitted with Dallmeyer's 6 by 5 Rapid Rectilinear Lens		...	14	16
No. 4.— $7\frac{1}{4}$ by $4\frac{1}{2}$ do., fitted with Ross' Symmetrical Lens		...	14	11
Do., do., fitted with Dallmeyer's Rapid Rectilinear Lens		...	14	16
No. 5.— $7\frac{1}{2}$ by 5 do., fitted with Ross' Rapid Symmetrical Lens		...	15	5
Do., do., fitted with Dallmeyer's Rapid Rectilinear Lens		...	15	0
No. 6.—8 by 5 do., fitted with Ross' Rapid Symmetrical Lens...		...	15	10
Do., do., fitted with Dallmeyer's Rapid Rectilinear Lens		...	15	5
No. 7.— $8\frac{1}{2}$ by $6\frac{1}{2}$ do., fitted with Ross' Rapid Symmetrical Lens		...	17	14
Do., do., fitted with Dallmeyer's Rapid Rectilinear Lens		...	18	4
No. 8.—9 by 7 do., fitted with Ross' Rapid Symmetrical Lens...		...	18	16
Do., do., fitted with Dallmeyer's Rapid Rectilinear Lens		...	19	4
No. 9.—10 by 8 do., fitted with Ross' Rapid Symmetrical Lens		...	21	14
Do., do., fitted with Dallmeyer's Rapid Rectilinear Lens		...	22	4

 Each Camera is fitted with 3 double backs only.

Double Action Swing Back, 9 by 7 and under, 15/- extra; 10 by 8, £1 extra.
Brass Binding Camera and 3 Backs, up to 9 by 7, 28/- extra; 10 by 8, 33/- extra.

International Exhibition, 1862—Highest Award.

Photographic Society of Scotland, 1863—Medal.

Berlin International Exhibition, 1865—Medal.

North London Exhibition of Arts and Manufactures, 1865—Medal.

Dublin International Exhibition, 1865—Highest Award.

Paris Universal Exhibition, 1867—Medal.

Edinburgh Photographic Society, 1876-7—Special Medal.

The above are the only Exhibitions where P. M. has been an Exhibitor; and the award of each Jury was for great excellence in design and manufacture of cameras.

MANUFACTORY—

21, SOUTHAMPTON ROW, HIGH HOLBORN, LONDON, W.C.

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PREFACE TO THE THIRD EDITION.

THE fact that two editions of this little book have been sold within a few months, seems to indicate that it does—in part, at least—fulfil the purpose for which it was intended, and that it is, to a certain extent, useful.

A Third Edition having been called for, it has appeared to the publishers and myself that the work might be somewhat extended without its losing what I should wish to be its chief feature—namely, conciseness. I have, therefore, added a few chapters, and have somewhat extended several of those which appeared in the first edition. I have added certain Tables, which will,

I hope, facilitate what is always the most difficult matter with a beginner—namely, judgment of exposure. I have also written a chapter on Portraiture Out-of-doors and in Ordinary Rooms, this branch of the art being one which the amateur is sure to aspire to, and in which there is, since the introduction of gelatine plates, a chance of his succeeding. A short description of the beautiful Platinum Printing Process is given, and an additional chapter on the Manufacture of Plates. An Index has also been added.

W. K. BURTON.

1, *Adam Street, Adelphi.*

London, W.C.

May, 1883.

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INTRODUCTION.

WE wish at the outset to explain our reason for writing this little book, and the object which throughout we shall attempt to bear in mind.

After Archer brought out his collodion process, photography for the first time became a popular amusement with those who had a leaning to art or science, or both. The scientific interest and novelty attaching to the then comparatively new process, combined with a totally false idea of how easy it would be, by means of it, to make a "picture," attracted enormous numbers of those who had some spare time on their hands to take up the subject as amateurs. After a time many of these found that their expectations were scarcely fulfilled, and they found, too, to their surprise, that a mere transcript from nature was not necessarily a picture, but that as much art culture, if not as much skill, was required to produce one when the tools were the camera and lens, as when they were the pencil and brush. They found, also, that the skill required was greater than they had supposed—that at least a slight knowledge of chemistry and of physics was necessary, or endless troubles would arise.

The realization of these facts greatly thinned the ranks of the amateurs. Another era has, however, now arisen in photography—the era of the dry gelatine process. The skill necessary to produce a photograph has been greatly reduced. The plate is now no longer prepared by bringing into contact, immediately before exposure, two fickle and uncertain chemicals—the “collodion” and the “bath”—but it may be purchased ready made, will keep, so far as we know, indefinitely, and may be exposed at any time. True, the artistic feeling is as necessary as ever; but that uncommon combination, a mind equally artistic and scientific, is required to a less degree than before, and wider scope is given to the former capacity.

The consequence of this is, that the number of amateurs is now enormously on the increase. The man who has but a few summer days to spare may take up the camera, and may work it with profit. There will probably be soon—if there is not now—an army of amateurs as great as there was twenty years ago. The ranks are continually being recruited, and greatly by those who have worked no other process before the gelatine one.

Now we come to the object of our “A B C.” How is the dry-plate aspirant, who takes up the gelatine process as his first, to gain the necessary information to enable him to practise the art? If he has a photographic friend—if his friend and he have coincident spare hours, and if his friend has the ability of conveying to others the knowledge which he himself possesses (an ability rarer than is generally supposed)—then the way whereby the would-be photographer is to gain his information is clear.

In very many cases, however, the beginner has no such friend; then, where is he to turn? True, there are several excellent manuals published on the gelatine process, but most are quite unsuited for beginners;

they presuppose a general knowledge of photography—at least, of the “wet process.” Then there are the directions contained in the boxes of plates which the tyro will purchase. They also are excellent in their way, but they are necessarily laconic—they, as well as the manuals, are addressed to those who already are not unacquainted with photographic processes. They constantly refer to the collodion process as a standard, and they use technical language which is unintelligible to the beginner. Let any photographer whose eye this may happen to meet try to cast his mind back to the times when he was tediously wading through the beginning of whatever was the first photographic process he ever worked. Can he remember when terms now so familiar to him, such as “detail in the shadows,” “density in the high-lights,” conveyed no idea to his mind? Perhaps he cannot; but such a time there certainly was for him, and now is for every one who first attempts to solve the mystery of the language in which the modern dry-plate manuals and instructions in the plate-boxes are couched.

We know the case of many who have commenced photography since gelatine became popular, and who, feeling the want which we have attempted to explain—of anything to guide them to a direct knowledge of the working of dry plates—have familiarized themselves with the more difficult wet process for the sole purpose of using it as a stepping-stone to the former. In speaking of the gelatine process as easier than the collodion, it must be understood that we go on the assumption that the dry plates are purchased from the manufacturer, not made by the photographer himself. No beginner should attempt to make his own plates. He will find that he has quite enough to do to learn to work those which are made for him by others. In fact, we consider that the most experienced photographer who is wise will buy his plates, unless he

takes an actual scientific interest in the manufacture. Dry plates can now be had so cheaply that he can scarcely expect to save money by making them. This, however, is a digression. To return to our subject. What we intend to do is to give instruction in the working of modern dry plates, addressed to perfect beginners. We shall use no technical terms, or only such as we have already explained, and shall assume no knowledge of any photographic process.

Our endeavours shall be to give such instructions that those beginners who will follow them carefully may, without any other assistance, after a little practice, be able to turn out, with a fair approach to certainty, technically perfect negatives on plates purchased from any trustworthy maker. We shall avoid theory altogether; nor do we intend to enter into the question of art. All we propose to do is to teach the A B C of the subject—the purely technical. To the higher branches of photography—the artistic—the aspirant must be guided mostly by his natural gifts; but he will find much to assist him in many advanced books on photography; we shall, however, give instructions in printing, so as to enable the student to complete his picture. In fact, our desire is to produce a manual of photography *for beginners*, on the assumption that the gelatine process is now *the* photographic process of the day.

Our last chapters will consist of concise instructions for the making of an emulsion and coating of plates, so that the amateur who chooses, for pure love of so doing, to make his own plates, may do so. Here, again, we intend to avoid all theory, nor shall we enter at all deeply into the question of emulsion making, as the subject has been very fully treated in two different manuals published by Messrs. Piper and Carter.*

* "Photography with Emulsions," by Captain Abney; and "Modern Dry Plates," by Dr. J. M. Eder.

We intend to devote a chapter to the subject of lenses, and to give a few very simple rules whereby the beginner may gain some idea of the exposure which will be required under different circumstances, and certain tables which will, for most cases, do away with the necessity for any calculation, even of the simplest kind. It is common in manuals for beginners to say that knowledge of the length of exposure can only be gained by experience. This is partly true, but not entirely. *Some* idea may be given of how long the cap should be kept off the lens under certain circumstances, and this, we believe, will greatly assist the beginner. The writer remembers how, when he commenced the study of photography, with no assistance but what he could get from the hand-books, he sought in vain for at least some faint clue to the length of exposure, and to the factors which regulated it.

CHAPTER I.

SELECTION OF APPARATUS.

THE first thing that the photographic beginner has to do, after he has made up his mind that he is going to take up the fascinating art-science, is to determine what size of "plate" he will work—that is to say, how large his pictures are to be. As a matter of course, he should begin work upon the smallest plates which he can buy, as the first few results are sure to be far from perfect, and the cheaper the plates spoiled the better. This does not, however, bind him to the smallest size. All photographic cameras are made so that several different sized plates will fit into them, and after the first difficulties are over, the tyro is sure to aspire to the production of something larger than the well-known "card" or carte-de-visite.

In considering size of plate to be worked, it must be borne in mind that the larger the plate the greater the weight to be carried into the field, the greater the difficulty of manipulation, and the heavier the expense at every turn. This being the case, we would suggest to our friends, as a good size, that known as "half-plate"; that is, a plate measuring $6\frac{1}{2}$ inches by $4\frac{3}{4}$ inches. This allows of pictures being taken of the popular cabinet

size, and the apparatus necessary can very easily be manipulated in the field. A somewhat larger size can easily be carried by an active man; but we should recommend that, at any rate, nothing greater than "whole-plate," or $8\frac{1}{2}$ inches by $6\frac{1}{2}$ inches, be attempted. The smallest size of plate commonly offered for sale is the "quarter-plate," measuring $4\frac{1}{4}$ inches by $3\frac{1}{4}$ inches, and, as we have said, the beginner should confine himself to this size till he has become somewhat familiar with the different operations involved in the taking of a negative.

Having decided the size, the next thing to consider is, in what manner to purchase the apparatus; and here we must say emphatically that the only way in which to be sure of getting reliable photographic requisites is to go to a first-rate dealer, and to purchase them new from him. There is a general idea in the mind of the non-photographic public, probably gained from seeing numbers of old cameras and lenses exposed for sale in pawn shops and such like, that great bargains are to be made in second-hand photographic apparatus, and that the beginner may "pick up" what he wants very cheaply by a little looking about. There can be no greater mistake. The experienced photographer may occasionally pick up an article very cheap; but the man without technical knowledge will be sure, if he attempt to do the like, to find on his hands goods which will be useless to him when he has somewhat advanced in his art.

Having thus advised our reader where to purchase his apparatus, there still remains the question, "How? Is it advisable to go in for a complete set, or to buy each article separately?" The beginner will be best advised in this matter by the state of his funds. The "sets" made up by most of the chief photographic dealers are most excellent and complete; but the sum charged for them is greater than many are willing to

lay out at once. These may buy at first only those articles which are absolutely necessary to begin with, and may add to their store from time to time, as they think fit. We give a list of the articles most necessary for working quarter plates, and afterwards shall say a word on such of them as seem to us to call for special description:—

A camera.

A lens.

A tripod stand.

A focussing cloth.

Three flat dishes or trays of porcelain or other material.

A graduated measure holding $\frac{1}{4}$ -ounce.

A graduated measure holding 4 ounces.

A dozen gelatine quarter plates.

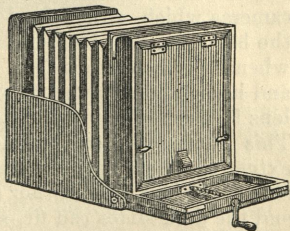
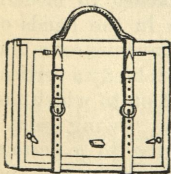
A dark-room lamp.

A chemical balance.

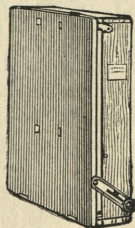
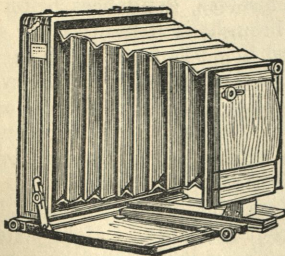
The general form of the photographic camera must be familiar to all. It consists essentially of a box, at one end of which is held a sensitive plate, whilst at the other is held a lens. An inverted image of any bright object which may be opposite the lens is thrown by it on to the sensitive plate. There is a means of adjusting the distance between the plate and the lens, or, as it is commonly expressed, of focussing. Every camera has, besides this, a piece of ground glass, which can be put in the exact place to be afterwards occupied by the plate, and upon which the image can be seen so as to facilitate focussing. It is also fitted with a "dark-slide." This is a sort of case in which a sensitive plate may be fixed. After the camera has been focussed, the dark-slide is placed in the position before occupied by the ground glass, which latter is removable. The "shutter," or sliding door of the dark-slide, is then removed, and, on taking the cap off the lens, the image

falls on the plate. As many dark-slides as are desired may accompany a camera, and thus a number of plates may be carried into the field. Slides are constructed to hold two plates each, and are called "double dark-slides." These are by far the best and most convenient to use for dry plates. Three slides are a common number to accompany a camera. This enables half-a-dozen plates to be carried out. Each dark-slide should be fitted with a set of "carriers." These enable plates smaller than the largest size for which it is constructed to be placed in it.

All modern cameras for use in the field are made so



that they can fold up into small compass for ease in carrying, and have "bellows bodies," that is to say, can



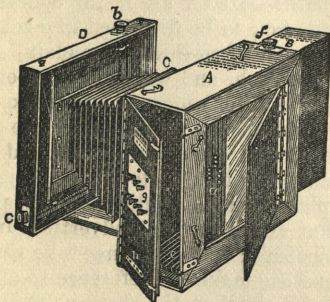
be drawn out and in like a concertina. We illustrate

two of the best modern forms of camera, showing in each the camera as in use, and as folded down for transportation. In purchasing a camera, the photographer should get one which will open to a considerable distance—if possible, to as much as twice the length of the largest sized plate which it will work. In some part of his career the amateur is sure to aspire to the taking of portraits. His attempts in this direction are likely to be failures, and to cause great pain to his friends, but nothing is surer than that the portraiture fit will attack him. When it comes to this, he will find a camera which opens to a considerable length a great advantage.

There are various adjustments attached to modern cameras which, although of little use in the hands of the beginner, will be found of great convenience to him when he is more advanced. These are chiefly a vertical and horizontal adjustment of the front on to which the lens is screwed, and what is called a "swing back." This latter provides a means of varying to a certain extent the angle between the sensitive plate and the axis of the lens. A leather case, into which the camera and the dark slides can fit, should be provided.

Various attempts have been made to obviate the necessity of having separate dark slides, and cameras have been constructed so that they either contained a supply of plates themselves, appliances being added to enable these to be brought into position, or so that the plates are contained in a box from which they may be transmitted to the camera without the intervention of more than one dark slide. Several of these cameras work very successfully. One of the most ingenious is that which has been called, after its inventor, the "Enjalbert." We illustrate it on page 11. It has all the adjustments of an ordinary camera, and, besides this, a receptacle for containing six or eight plates, any one of which may, by a most ingenious device, be made to take the place of the ground glass.

Next in importance to the camera—if, in fact, it is not more important—comes the LENS. As we intend to



devote a special chapter to lenses, we shall not go much into the question just now, but shall merely advise that what is known as a "single achromatic" lens, of such a length of focus as to enable the largest plate which the camera will hold to be covered, should be purchased. The lens should be bought direct from some reputed maker. The particular form of lens known as the "wide angle landscape" is the best.

The tripod-stand calls for little special remark. Its general form is known to all. In those of modern construction each leg folds into two, so as to make the whole more portable. The only requirements of the camera stand are that it should be light, should be easy to fit up and take down, and should be quite rigid when fixed up.

The focussing cloth is intended to cover the head and ground glass, thereby shutting out extraneous light, and making it possible to see the image given by the lens sufficiently distinctly to adjust the focus. It should be about four feet square. Velvet or velveteen

is the best material to use, but any black and opaque cloth will do.

The flat dishes or trays—or, as they are sometimes called, flat baths—are for use in the operation of developing, fixing, &c., to be described in a future chapter. Such dishes, made of so-called porcelain, can be had for a few pence each, and we should recommend that these be purchased for quarter-plate work. When the photographer advances to larger sizes, he may indulge in the more expensive and more convenient dishes made of ebonite and other light material.

The dry plates can be bought from any photographic dealer. They are extensively advertised in the photographic periodicals; but we cannot take upon ourselves to recommend one make in preference to another. We have found all excellent, the cheap as well as the more expensive.

The dark-room lamp will be described when we come to the chapter on the “dark-room.”

The most convenient balance for photographic use is such a one as druggists weigh out their chemicals in; but a small pair of scales without stand, such as are sold for about half-a-crown, will do well. For practical photography, weighing apparatus of great delicacy is by no means necessary. A set of grain and drachm weights are necessary. The system known as “Apothecaries’ weight” is adopted throughout this book, because it is that most generally used for practical chemical and photographic work in this country. It is unnecessary to say that the French decimal system is vastly superior.

CHAPTER II.

CHEMICALS.

AFTER the photographer has provided himself with the necessary apparatus and plates, his first consideration must be the purchase of the chemicals which he will require to convert his plates into negatives. We give a list of those which he will need, stating after each about the quantity which we think it desirable that he should possess himself of at first. Afterwards we give a few words describing the general properties of each substance, but not entering into the chemical composition. Each chemical, whether liquid or solid, should be kept in a bottle, which should have the name distinctly labelled on it, if possible in print.

The chemicals required are as follows:—

Pyrogallic acid	...	...	...	1 ounce
Ammonia of specific gravity .880	...	...	...	3 or 4 ounces
Bromide of ammonium	...	...	...	1 ounce
Neutral oxalate of potash	...	...	...	$\frac{1}{2}$ pound
Sulphate of iron	...	...	...	$\frac{1}{2}$ pound
Citric acid	...	...	...	1 ounce
Hyposulphite of soda	...	...	...	1 pound
Alum	...	...	...	$\frac{1}{2}$ pound
Methylated spirit	...	...	...	$\frac{1}{2}$ pint
Bi-chloride of mercury	...	...	...	$\frac{1}{2}$ ounce
Negative varnish	...	...	...	A few ounces

A couple of books of test-papers, one of blue litmus, and one of red litmus.

Pyrogallic acid is a white, feathery, and extremely light body. It is exceedingly soluble in water. It is a powerful absorber of oxygen, especially when alkaline. When a solution of it has absorbed oxygen, it turns brown.

The ammonia used in photography is the strongest solution of ammonia which it is possible to make in water at atmospheric pressure. It is the well-known hartshorn. It is a transparent and colourless fluid. It is powerfully alkaline. When the stock has been purchased, it is advisable to pour it at once into a bottle holding exactly double the amount of the ammonia, and to fill up the bottle with water. If this is not done, the stopper of the smaller bottle may be blown out by the pressure of the liberated ammonia gas when the weather is warm. This will destroy the whole, as, on exposure to air, the liquor ammonia rapidly becomes weaker from the ammonia gas escaping.

Bromide of ammonium is usually found as a white powder, looking very much like ordinary table salt. It is very readily soluble in water.

Neutral oxalate of potash is a white crystalline body. It is readily soluble in water. It ought to have neither an acid nor an alkaline reaction; but often that sold as neutral is somewhat alkaline.

Sulphate of iron, or "copperas," is a greenish crystalline body. It is very soluble in water, but requires considerable time. Its solution decomposes readily if it be at all exposed to the air, on account of its absorbing oxygen; after this it is useless for photographic purposes. It should therefore be kept—after it is dissolved in water—in a closely-stoppered bottle.

Citric acid is met with either as clear colourless crystals, or as a powder. It is soluble in water.

Hyposulphite of soda is a clear colourless crystalline body, and is somewhat deliquescent—that is, if left

exposed to the air it becomes damp. It is readily soluble in water.

The alum used may be the ordinary alum sold by grocers. As it is intended to be dissolved in water, it should be bought in the form of a powder. It does not dissolve in very large quantities in cold water, and dissolves somewhat slowly.

Methylated spirit calls for no particular notice, as it is well-known to all. That sold as "finish" is not suitable for photographic purposes.

Bichloride of mercury is a whitish crystalline substance. It is sparingly soluble in water, and is an active poison. It is commonly known as corrosive sublimate.

Negative varnish in appearance is very like the ordinary spirit varnish used for varnishing wood, but differs from it in the resins used to manufacture it. It can be bought from any photographic dealer. That sold as "dry plate negative varnish" is the most suitable.

The test-papers are for discovering whether a liquid, such as a solution of any salt, is neutral, acid, or alkaline. To use them, proceed as follows. Suppose you have a solution of whose condition as regards acidity or alkalinity you are ignorant. Dip a small piece of the blue litmus paper into the solution. If the paper changes its colour to red at once, or after a short time, the solution is acid; if no change in its colour takes place, the solution is either neutral or alkaline. In this latter case, dip a piece of the red litmus paper into it; you will now know its exact condition. If the red litmus becomes blue, the solution is alkaline; if no change takes place, it is neutral.

We have now enumerated and shortly described the necessary chemicals, and shall give instructions for mixing one or two of what are called "stock solutions." These are solutions which may be kept for some time, and which the photographer should have by him. The

ones we now describe are those to be used in the first lesson in development.

No. 1 bottle is to be labelled "*Solution of Oxalate of Potash*," in large letters, so that it may be read in a very dull light. Place the whole half-pound of neutral oxalate of potash in a bottle capable of holding from ten to twelve ounces. Fill up the bottle with warm water, place in the cork, and shake. A part, but not the whole, of the white crystals, will dissolve. The liquid will be what is called a "saturated solution"—that is, the water will have taken up as much of the salt as it is capable of doing. When any of the solution is used, the bottle should again be filled up with water, and this may be done repeatedly till all the crystals are dissolved, the bottle being well shaken after each addition, when more oxalate of potash must be purchased. This solution must be tested in the manner described above to discover whether or not it is alkaline. If it is, enough citric acid must be added to make it neutral or very slightly acid.

No. 2 is to be labelled "*Sulphate of Iron Solution*." Place about a half of the sulphate of iron in a half-pint bottle, and proceed exactly as with the last stock solution. It is very necessary in this case to keep the bottle always full of solution, and well corked, as the oxygen of the air, if it come in contact with the liquid, very rapidly spoils it. The solution should be of a bright green colour. If it gets red, it is useless.

No. 3. *Ammonium Bromide Solution. One per cent.*—Weigh out twenty grains of ammonium bromide. Place in a four-ounce bottle, and make up to four ounces with water. The percentage is not exactly correct, but is quite near enough for the purpose.

No. 4. *Alum Solution*.—Place three or four ounces of the alum in a pint bottle. Fill up with warm water. The whole of the alum will probably dissolve, but some of it will be thrown down again as crystals when the

solution becomes cold. As long as these last, more water may be added from time to time, as the solution is used. When they are all dissolved, alum must be added.

No. 5. *Fixing Solution*.—Place five ounces of hyposulphite of soda or “hypo.” in a pint bottle, fill up with warm water, and shake till all is dissolved.

Common tap-water may be used for all these solutions, which, stated briefly, are as follows :—

- No. 1. Saturated solution of oxalate of potash.
- No. 2. Saturated solution of sulphate of iron.
- No. 3. One per cent. solution of bromide of ammonia.
- No. 4. Saturated solution of alum.
- No. 5. Twenty-five per cent. solution of “hypo.”

CHAPTER III.

THE DARK ROOM.

Our friends will understand that the plates which they are about to work with are of the most "exalted sensitiveness;" that is to say, a very small amount of light allowed to act on them will produce a change which may be made visible. We must explain, however, that it is only certain rays of light which have the power of making the change which we mention. All our readers who have a little knowledge of physical science know that white light is in reality a combination of light of all the beautiful colours which we see in the rainbow, and that if we pass a ray of white light through a prism, it will be broken up into all these colours. The order of them is—violet, indigo, blue, green, yellow, orange, and red. Those at the beginning of the list are called rays of high refrangibility; those at the end, rays of low refrangibility. Now, it is a curious fact that the photographic change which is worked in a sensitive plate is worked entirely by the rays of high refrangibility, principally by the violet and the blue, which are said to be "actinic;" whilst the red, which is said to be "non-actinic," has no effect at all. Were it not for this peculiar fact, photography

would be almost impossible, because we could find no light in which we could manipulate our plates without their being affected, and consequently destroyed. As it is, however, we only require to secure some place illuminated by those rays which do not have any photographic action, and we can work quite freely. In other words, we want a room lighted with only red light in which to work.

Photographers give such an apartment the name of "dark-room," although the term is a misnomer. On the dark-room, then, we propose to give what hints we consider necessary for the beginner.

It is scarcely to be expected that the young amateur, taking up the subject of photography for the first time, will have the power of obtaining the exclusive use of a room of considerable size, to convert into a dark-room; but, on the contrary, he will probably have to put up with some temporary arrangement; nor is it at all necessary, even when he advances considerably, that he should have a permanent dark-room, unless he intends to make his own plates. Any room or closet from which all the outer rays of light can be shut off may be converted into a dark-room, in which plates may be changed and developed. If a room having a sink and water tap—if, say the pantry—can be "annexed" for the time being, the trouble will be greatly reduced; but it is quite possible to make shift with a pail for a sink, and a water jug instead of the tap.

We have said that it is necessary to shut out entirely all daylight. This pre-supposes the use of artificial light for illuminating the apartment with the necessary red or non-actinic light. We consider that until such time as the student sees his way to fitting up a permanent dark-room, he will find it best to work with artificial light. Lamps constructed especially for the purpose of giving "safe" light are sold by all dealers in photographic apparatus. These use either

gas, oil, or candles, and all consist of an arrangement whereby the air necessary to support combustion is introduced by passages which will not allow white light to find its way out, the colour of the light being modified by funnels or globes of ruby glass, or shades of ruby paper or cloth. The gas and oil lamps are much to be preferred to the candle arrangements, as with the former it is possible to raise or lower the light at will.

All, then, that the photographer has to do, is to find some small room or closet, which he can make quite dark, in which he can have a plain deal table to work upon, and to purchase a "dark-room lamp" from a photographic apparatus dealer. Our description of dark-rooms would not, however, be complete, unless we say something about the fitting up of a permanent photographic room in which all the operations, including the manufacture of the plates, may be conducted. On page 21 we give a sketch of such a room.

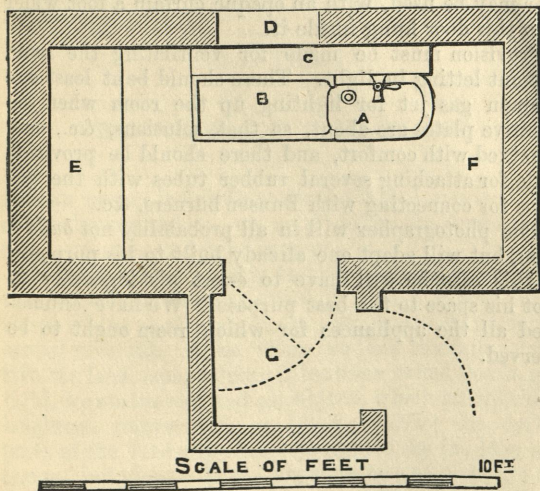
D is a window whereby the necessary light is introduced. It should be about two feet long, by one foot six inches high, and should be glazed with one thickness of ruby, and one thickness of orange glass. On the inside there should be a blind of red Turkey cloth, which can be raised and lowered at will. This is to reduce the amount of light when the sun shines directly on the window, or when the process of plate manufacture goes on.

A is a sink made of glazed stoneware. The top edge should be about two feet six inches, or two feet eight inches, above the floor.

B is the operating-table. It should be covered with sheet lead, should have a very narrow and low ridge round all the sides except that next to the sink, should have a very slight incline in that direction, and should have the sheet lead "dressed" over the edge of the sink, so that all spillings may find their way into it.

C is a narrow shelf about four inches above the level

of the table and sink, and extending along the whole length of both of them. On it is placed the lamp when artificial light is used, as when working at night, and the bottles of solutions actually used for development. The lower edge of the window should be an inch or two above this shelf. There should be a shelf about six inches below the operating-table, on which the flat developing dishes may be kept.



E is a table on which the levelling-slab may be placed when the manufacture of plates is commenced. Above it—or, in fact, along all available space of the walls—shelves may be fixed for carrying bottles, &c.

A space is reserved at F for the drying-cupboard, used in manufacturing plates. Above this latter, and with its lowest edge about three feet higher than the floor, should be fixed an ordinary cupboard, with a door

closing light-tight. In this may be placed plates or anything sensitive to light, which would be destroyed if left about; for it must be understood that even light of the deepest ruby red will in time act upon a sensitive plate.

G is an arrangement of double doors, whereby the photographer may go out or in without letting any light enter. If there be not space for this arrangement, one door may be used, with an opaque curtain a foot wider than this door hung inside it.

Provision must be made for ventilating the room without letting in light. There should be at least one common gas jet for lighting up the room when no sensitive plates are about, so that solutions, &c., may be mixed with comfort, and there should be provision made for attaching several rubber tubes with the gas pipes for connecting with Bunsen burners, &c.

The photographer will in all probability not *build* a room, but will adapt one already built to his purposes. In this case he will have to exert his ingenuity to allot his space to the best purpose. We have enumerated all the appliances for which room ought to be reserved.

CHAPTER IV.

EXPOSURE OF THE PLATE.

BEFORE giving instructions in the actual manipulation of developing a plate, we must define the terms negative, exposure, and development.

A negative may be said to be a pictorial representation, which, on looking through it at a bright light, shows all the shades which are seen in any object represented reversed. Thus, when we look through a negative of a landscape, holding it between us and (say) a gas-light, we see the sky and all objects which are in reality brightest, represented as black; whilst the darker parts of the landscape are represented by the bare and transparent glass. If the negative be a portrait, we see the face black, looking like a negro's; whilst a black coat looks white, and so on. The negative is produced by the action of light in the camera, the places where the light has acted most strongly being turned black. The time during which it is necessary for the light to act on the plate to produce the required effect is called the exposure. Now, we have said that the light acts upon the plate and darkens certain portions of it, but it must be understood that this action is not at first visible.

A marvellously short exposure is sufficient to impress on a plate all the details of a landscape in such a manner that, by afterwards acting upon the plate with certain chemicals, these details may be made visible. This operation is called development, and consists essentially in the increasing of the strength of an image so faint as to be invisible to the eye, till it becomes as vigorous as we desire. Anyone, however unacquainted with photographic operations, will perceive that when once we have obtained a reversed picture, such as we have described, we have nothing to do but to place this in contact with a sensitive film, and allow light to act through the negative, when we shall get a picture with its shades true to nature. The latter process is usually performed with sensitive paper, and is termed printing.

Upon correct exposure and development, nine-tenths of the technical success of negative-making depends; and when once the student has thoroughly mastered the relation of the one to the other, half the battle will be over. He cannot do so without practice; but we hope to give him such assistance in explaining the matter as may lead him to the desired end as quickly as possible.

Let the beginner select an object upon which he will make his first attempt. If he can resist the temptation to try a portrait, so much the better. A brightly-lighted landscape, with strong contrasts of light and shade, is the best; it need not be picturesque. A suitable view can generally be got out of some window, or a very suitable subject is a bust or statue placed either in a well-lighted room or out of doors. We shall suppose in the present instance that the landscape is selected. The camera should point neither towards nor away from the sun. If the sun shine direct into the lens, the plate will be destroyed; if the sun be directly at the back of the camera, the picture will look "flat."

Before beginning operations, we wish to explain

what is the meaning of correct exposure. Let the student look attentively at the view which he has selected to make his first attempt upon. He will see that, apart from the various colours represented, there is a very great range of light and shade. He knows that this range is brought about by the fact that different objects reflect different amounts of light to his eye. Probably the sky will reflect the most light, and going through the whole range from this he will see that there are a few little bits of the landscape that appear absolutely black. They do reflect some light, but it is so little that by contrast with the brighter objects they appear to reflect none. Now, let the student consider the process which goes on during exposure. He knows that when he has his camera with a dry plate in position, and when he has removed the cap of the lens, a perfect picture of the landscape, with all the shades of light, will be thrown on the sensitive film, and that the light will be acting upon it. Now it is evident the brighter parts of the picture will first take effect, and afterwards the darker, until the exposure has been prolonged to such a period that all the shades of light except those which, as we explained, appear in the landscape absolutely black, will have impressed themselves. At this point the correct exposure has been given. Had a shorter time been allowed, some of the darker shades—or, as it is technically called, the detail in the shadows—would have failed to impress themselves, and the resulting negative would have been said to be under-exposed. On the other hand, had the exposure been prolonged, the light emanating from the apparently black parts of the landscape would have impressed the plate, which would eventually appear to be darkened all over, and would be said to be fogged from over-exposure. It is said of a correctly-exposed negative, that it shows all the detail in the shadows without being fogged.

Now we shall pass on to the practical exposure of a plate, and shall show the student how he can tell, by the behaviour of the plate during development, whether he has hit the much-desired correct exposure, or not.

He will require to light his dark-room lamp, and to get by him the three flat dishes, the two measuring glasses, all the stock solutions which we gave directions for mixing in a former chapter, and his box of dry plates.

Now let him place his camera in position, opposite the view to be photographed: let him remove the cap from the lens, and place his head under the focussing-cloth. He should remove the stop from the lens entirely, if it has movable stops, or, if the stops be rotary, should turn them till the largest one is in use. This will make the image on the ground glass very bright, and, by turning the focussing screw first one way, then the other, he will easily find in what position the image is the sharpest. When he has discovered this, let him place the smallest stop in the lens. We say the smallest stop, not because it is necessarily the best for the picture which he is going to take, but because it will enable him to give a comparatively long exposure.

Having his camera fixed and focussed, let him place the cap on the lens once more, and retire to the dark-room with one of his double dark slides for the sensitive plates.

When once here, he must place the dark slide open in front of the lamp. Now he must lower the light till there is only just enough to enable him to see. He must open his plate-box and take out two plates—two glasses must be placed in the dark slide at once, but one may be a “dummy” if he happen to have but one dry plate; that is, either a clean plate of glass or a spoilt negative. In placing the plates in the slide, let him be very careful that in each case the side of the plate which appears dull, on account of its having the sensitive

film on it, is placed towards the outside. Now, having closed his dark slide and wrapped his plates up again, let the photographer return to the camera. He should carry the dark slide under the focussing cloth, for further security against light; and in placing the slide in the camera and during exposure should keep the whole apparatus, with the exception of the lens, under the cloth for the same reason. He removes the focusing screen, and places the dark slide in the position occupied by it, keeping the side marked 1 towards the lens. He now withdraws the sliding door, which is the only thing which intervenes between the lens and the sensitive plate. He takes his watch in his hand, and removes the cap from the lens for (say) five seconds, replaces it, slides in the shutter of the dark slide, and carries the latter off to the dark-room. We have supposed any of the usual view lenses to be used, the landscape to be brightly lighted, the time of year to be spring or summer, the time of day morning or noon, and the plates to be rapid.

CHAPTER V.

FIRST LESSON IN DEVELOPMENT.

IN the last chapter we left the photographer at that stage where he had accomplished the exposure of a plate, and was about to commence the development. We should explain that the developer with which he is going to make his first experiment is that known as ferrous oxalate. When he has somewhat advanced, we should recommend him in all cases to use the exact developer recommended in the printed instructions contained in the plate-boxes. This will generally be that known as "alkaline pyrogallie," but the ferrous oxalate has the advantage of such extreme simplicity that it is most suitable for a beginner, and, mixed as we recommend it, will give good results with any commercial gelatine plates of which we have had experience.

The photographer has now, we shall suppose, returned to his dark-room. He may lay his dark slide, still wrapped in the cloth, on a shelf, and, turning up the white light, make the following preparations. He lays his three flat dishes in a row along the front edge of the table, the one to the left opposite the red light, the others to the right of this one. We shall call the dishes Nos. 1, 2, and 3, beginning at the left. Into

No. 2 he pours two or three ounces of the alum solution ; into No. 3 about the same quantity of the "fixing" or "hyposulphite" solution. Now he takes the four-ounce measure, and pours into it exactly two ounces of the potassium oxalate solution. To this he adds half-an-ounce of the sulphate of iron solution. The whole will immediately assume a beautiful ruby red colour ; to it he adds about 40 minims of the one per cent. solution of bromide of ammonium. He will now have about $2\frac{1}{2}$ ounces of developer. This is an extravagant amount to use for a quarter-plate, and, if the photographer continues to use ferrous oxalate, he must reduce it to one-half ; but at first it is best to use a good dose. Everything is now ready. The white light must be entirely extinguished, and the red light lowered as much as possible, till there is just enough to see by. The plate which has been exposed must be carefully removed from the dark-slide, and laid—film side upwards—in dish No. 1, which is still empty. Now the dish with the plate in it is taken in the left hand, and the measure with the developer in the right. The developer is poured rapidly, but gently, over the plate, the dish being waved or rocked to make the liquid cover any corner which it may incline to avoid, and the whole is placed again in front of the red light. And now (if everything has been rightly done) will commence one of the most wonderful of the phenomena of science or nature which man has been given the power to control—a phenomenon which is always new and always beautiful—the "development of the latent image." Let the beginner watch it closely. The plate had no indication of having been acted upon at all before the developer was poured over it. After, perhaps, ten or twenty seconds there is a slight darkening of some part. When this becomes distinctly visible the light may be somewhat raised, for the plate has become less easily affected by it. It will now probably be seen that the

brighter parts of the landscape have become quite visible. In *negative*, be it remembered. The sky will be represented by blackness. Now is the time when we can tell whether or not the exposure has been correct. If it has been, the development will progress with beautiful regularity. The bright parts (or high-lights) appear first; then slowly, but steadily, more and more of the half-tones, or less brightly-lighted parts, come out; and at last every object and shade except the deepest shadows have their counterpart in the negative. In other words, the plate should be darkened to a greater or less extent in all parts except those few which represent the part of the landscape which appears to the eye quite black; and this should come about in between one and two minutes. If the plates have been under-exposed it will be longer before the high-lights appear, and very soon after they do the action will stop, no more detail coming out, but large patches of the plate remaining white as before. If, on the other hand, it has been over-exposed, the high-lights will appear a little sooner, and almost immediately afterwards the whole of the plate will be covered with detail, no part remaining white.

The final result of incorrect exposure is, with under-exposure, a hard picture with contrasts over-marked, and with deep heavy shadows in which none of the detail which is visible to the eye is represented; with over-exposure, a flat, uninteresting-looking production, showing all the detail which there is in the original, but lacking the bold contrast of light and shade.

We shall suppose the happy medium to have been hit, if not at the first attempt, after a few plates have been exposed. The development is not of necessity finished when, looking on the surface of the plate, all action seems to have ceased. We have still to wait till the "density" is sufficient.

A little reflection on the principles involved in the

process of printing which we briefly described in a former lesson will show that not only is it necessary for the production of a harmonious picture to have all the details which are in the original represented, but in the negative these must be represented by a certain definite amount of opacity—or, as it is usually called, density. It must be understood, then, that as long as the plate lies in the developer, even after, looking down upon it, all action seems to have stopped, the density continues to increase. We may say at once that the most difficult thing of all to judge of in gelatine dry plate work is when the required density is gained. So difficult is this, that even the most experienced photographers may occasionally fail. The reason of this is that the after processes very much modify the apparent density of the negative, and not only that, but in every different make of plate the apparent density is modified to a different degree. We must make it appear far denser than it is eventually to be. It is only by experience that knowledge approaching to exactness can be gained on this point. When we come to the chapters on printing, we shall explain more fully the characteristics of an over dense, and a “thin” or under dense negative. Just now we will merely indicate the manner in which it is usual to judge of the density. The red light must be turned pretty high. The plate must be lifted from the developer, and held, with the film side towards the observer, for a second only, close to the light, and between the light and the photographer. He must rapidly judge whether or not the density is correct. We may say roughly that, as a rule, the densest parts should appear almost, if not quite opaque. If they do not, the plate must be returned to the developer.

We shall suppose the correct density to have been gained. The time taken with the developer we have given will probably be from two to five minutes. The developer is now poured back into the measure. If used

within an hour or so, one or two more plates may be developed with it. The plate is now thoroughly rinsed under the tap, being either held in the hand, or left in the flat dish. After this, as much red light may be admitted as is desired. Then the plate is laid for five minutes in the alum solution, to harden the gelatine film. It is again thoroughly rinsed, and placed in the fixing solution. It will have been observed that up till this time the plate, looked at from the back, still appeared white. This is because the sensitive salt of silver which was not acted upon by light still remained in the film. On placing the plate in the hyposulphite, this whiteness will gradually vanish. When there is no farther appearance of it from the back, white light may be freely admitted. The plate must still be left a few minutes in the fixing solution, after which it must be most thoroughly washed. It should remain at least half-an-hour either under running water, or in frequent changes of clean water. After that, it is reared up on edge to dry, when the negative is complete. Heat must on no account be used in drying.

CHAPTER VI.

LENSES.

OF all the apparatus which the photographer uses, there is none of so great importance as the lens. With a bad camera, shift can be made and excellent work turned out, the only drawback being more labour and inconvenience for the operator; but with a bad or unsuitable lens, nothing good can be done. This being the case, it behoves us to give a short description of the various lenses in use, saying for what kind of work each is best suited. Before doing so, however, we will give a few general facts with regard to lenses, and especially we shall lay stress on the manner in which it is possible to compare the rapidity of different lenses. It will be necessary to define a few technical terms continually applied to lenses.

By *depth of focus* is meant the power in a lens to represent sharply objects both near and far from the lens. The larger the aperture or the longer the focus of the lens, the less the depth of focus. With every lens is supplied a set of *stops* or *diaphragms*. These are simply plates with holes of larger and smaller sizes in them, which are made to slip in front of or between the combination of a lens. The more depth of focus is required, the smaller a stop must be used, and consequently the slower the lens will be.

By *width of angle* is meant the amount of picture

which can be included without falling off of definition towards the edges of the plate. We shall suppose that a camera with a certain lens is placed opposite a row of houses. It may be found that only the central part of the ground glass shows a sharp image, all beyond being "fuzzy," or even dark. Possibly two houses are represented correctly. This is a *narrow angle* lens. Now we will suppose another lens of different make, but of the same focal length, to be substituted for the first. The two houses which gave a sharp image on the ground glass before will give a precisely similar image now, but possibly a house on each side of these will also be defined sharply. In this case the lens is called a *wide angle* one. It must be understood that narrow and wide angle lenses give images of the exact same size if the focal lengths be the same; the latter lens takes in a wide angle only on a larger plate, or on the same sized plate only by using a lens of shorter focal length.

Distortion is a fault met with in some photographic lenses. It causes straight lines near the margin of the object to be represented by curved lines in the image.

Flatness of field is the quality in a lens of having the definition at the edge of the plate good, as well as that at the centre. *Wide angle* and great flatness of field are almost synonymous terms.

The *focus*—or, more strictly speaking, the *focal length*—of a lens is the distance between the lens and the ground-glass when the image is sharply focussed. In a single lens the measurement is taken from the centre of the lens. With compound lenses it is near enough for all practical purposes to measure from the diaphragm to the ground glass.

The *aperture* in a lens is the diameter of the stop or diaphragm, or, where none is used, of the smallest of the actual lenses.

The *rapidity* does not require to be defined, but we propose to explain the factors which regulate it.

Every lens is of different speed from others of another form, and each lens has a number of diaphragms varying its rapidity, so that at first sight it might appear a difficult task to put a value on the speed of a lens using any particular diaphragm. The law which governs the rapidity of lenses is, however, so very simple that its application is most easy, and we would try to impress on the beginner that he should thoroughly master it at the commencement of his practice. If he does so he will find the estimation of the necessary exposure a comparatively simple matter. In changing one stop for another, or one lens for another, he will have nothing to guess except the intensity of the light. We give, further on, a set of tables which almost entirely do away with the necessity for even this small amount of calculation.

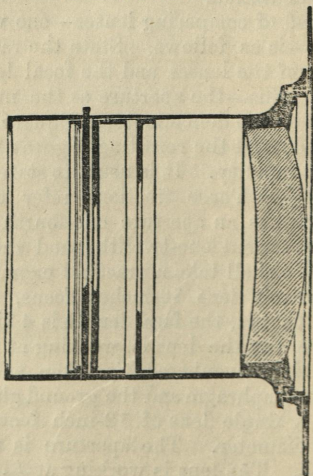
The method of comparing lenses—one which applies to all lenses—is as follows. State the ratios between the aperture of the lenses and the focal lengths of the lenses as fractions—the aperture as the numerator, the focal length as the denominator. Square the fractions thus obtained, and the resulting figures will give the ratios of the rapidity. It is usual to state the fractions thus: $\frac{f}{4}$ $\frac{f}{12}$ $\frac{f}{40}$. These fractions refer to lenses the first of which has an aperture one-fourth of the focal length, the second one-twelfth, and the third one-fortieth. We shall take a practical example. We are using a portrait lens 10-inches focus, and aperture $2\frac{1}{2}$ inches; that is, the focal length is 4 times the aperture, or we say the lens is working at $\frac{f}{4}$. The focal length, be it remembered, is taken as the distance between the diaphragm and the ground glass. We now substitute a single lens of 12-inch focus with a stop $\frac{3}{4}$ -inch in diameter. The aperture is now $\frac{1}{16}$ of the focal length. The lens is working at $\frac{f}{16}$. Square these two fractions, thus:—

$$\left(\frac{1}{4}\right)^2 = \frac{1}{16} \quad \left(\frac{1}{16}\right)^2 = \frac{1}{256}.$$

The rapidity of the lenses is as $\frac{1}{16}$ to $\frac{1}{256}$. The exposure required will therefore be as 16 to 256, or as 1 to 16. Thus, if we had been giving two seconds with the portrait lens, we should have to give thirty-two seconds with the single lens. If the beginner will exercise himself in this rule for a little time, he will find that he soon gains wonderful facility in applying it, and that it gives him a very great power in estimating the necessary length of exposure. With the same lens and different stops the rapidity varies as the square of the diameter of the stop, or as the area of the stop.

We shall now go rapidly over the different kinds of lenses most in use, giving the purposes for which each particular form is best adapted. We have first

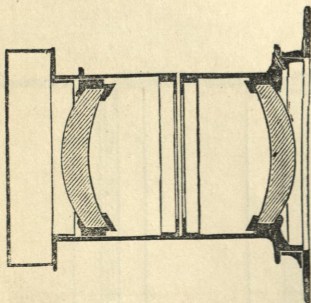
THE SINGLE LENS.



It is the one with which we should recommend the beginner to provide himself, as it is the simplest form

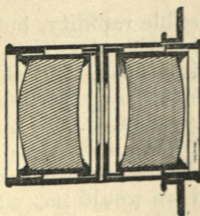
of lens, and is also the most generally useful. It is fairly rapid, has a fairly large angle, and gives wonderful definition and depth of focus. Its only drawback is that it gives slight distortion. If, for example, it be attempted to photograph a building of large size with it, the boundary lines will appear slightly curved, and the building will appear barrel-shaped.

THE RAPID RECTILINEAR OR RAPID SYMMETRICAL



is one of the most useful of lenses. It is very rapid, and one should be purchased when the photographer has so far advanced as to wish to attempt instantaneous effects. It gives no distortions, and about the same angle as the single lens.

THE SYMMETRICAL OR WIDE ANGLE RECTILINEAR

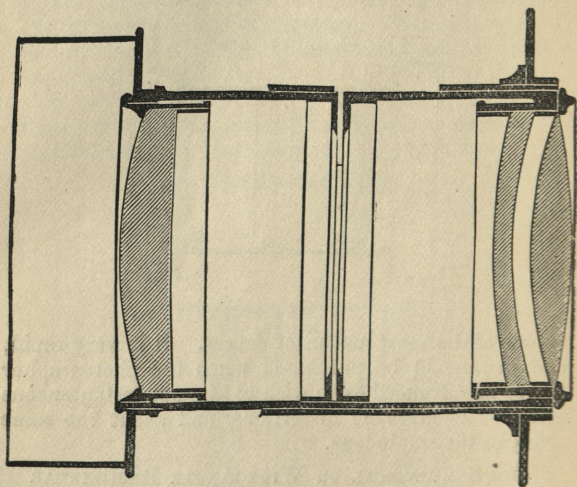


is a slow lens, but takes in a wonderfully wide

angle, so that it is useful for photographing objects when it is impossible to get the camera far enough away from them to use the rapid rectilinear. It is quite free from distortion.

THE PORTRAIT LENS

is intended for portraiture pure and simple. The utmost ingenuity has been spent in the case of this lens to



get the greatest possible rapidity, but many other good qualities have been sacrificed. Thus the field is round, the marginal definition bad, and there is very little depth of focus. For its own particular purpose it is, however, admirably adapted. With the very rapid plates which can now be had, it is quite possible to take portraits even indoors with the rapid rectilinear or the single lens, and we would not advise the beginner to purchase a portrait lens.

There are numerous photographic lenses sold under names different from any of the above, but all of them will be found to be very similar to one or other of the kinds described. As we are entirely avoiding in these lessons all historical reference, we shall not say anything of these forms of lenses, which have now almost gone out of use, and are not manufactured.

CHAPTER VII.

THE MANAGEMENT OF THE CAMERA IN THE FIELD.

IF the photographer have diligently perused our former chapters, and have gone through the various manipulations which are described in them, he will now be ready to sally forth into the field, and, selecting the beauty spots of nature, to transcribe them by the aid of his camera and lens. He may, in fact, make pictures.

We have declared our intention of not entering into the question of art in connection with photography, but have referred our readers to more advanced works for guidance in this direction. Yet we may make a few general remarks on the subject, especially in indicating those points wherein the requirements for a photographic picture differ from those for a painting. The chief of these arises, of course, from the absence of colour in the former. We cannot have transcribed by the camera the broad contrasts which are frequently brought out by colour alone. We must trust entirely to form and to light and shade. Very frequently a scene will make a most perfect picture on the camera ground glass, when the experienced photographer knows it

will make nothing in the print. Alas! the colour which makes the picture cannot be reproduced.

This makes it all the more necessary in the case of the camera to have the outline and the shades of light harmonious and well balanced, for on them alone must the picture depend. The picture must not be all on one side, nor yet should it be in each half similar. The most striking objects should not be in the centre of the picture, but somewhat to one side or the other. The horizon line should, as a rule, be about one-third of the height of the picture, either from the top or the bottom. There must not be too large patches of either very dark shade or of light without some small portions of the contrary shade to relieve them. There must not be running in any direction through the picture long and uninterrupted straight lines.

For the rest, there is wanting to a perfect landscape picture—be it painting, drawing, or photograph—a foreground, a middle distance, a distance, and a *principal object*. This latter is generally situated in the middle distance. It is in the distance that photography most frequently fails. What to the eye appears a definite distant landscape, the distance but lending enchantment and softness, comes out in a photograph so dim and faint, that it would seem to be almost hidden by a thick mist. The slight haze which, in this country at least, always stands between us and the distance, is exaggerated so as almost to obscure those things which are quite clear to the eye. A certain amount of haze covering the most distant objects in a photographic landscape is, indeed, necessary to give the idea of distance at all, and on the way in which this is managed will depend, more than on anything else, the success or failure of the picture from an artistic point of view. The difficulty is to be found in this, that the haze actually seen is always greatly exaggerated in the camera. It is therefore necessary to allow

for the difference between what is seen in nature and what will be the result in the finished picture.

Perhaps the greatest difficulty in photographing, however, is that the sky is not, as a rule, rendered at all. An exposure which will suffice to bring out all the detail in a landscape is such that the sky will be so over-exposed as to show no trace of cloud. It is necessary, to get the sky, to make a special exposure, perhaps about one-tenth of that required for the landscape, and to resort to a "double printing" process, which it is without our province to describe.

We shall briefly describe the subjects best suited for the camera. Any landscapes having, apart from colour, broad and well-marked contrasts of light and shade, and decided outline of form, are specially suitable. Trees of all kinds are well rendered, both with and without their leaves; in the former case, the difficulty is to get them motionless. A quite windless day is necessary. Architectural subjects of all kinds are most perfectly reproduced by the camera.

The most charming effects of all are, perhaps, produced in a scene in which there is water—a quiet pool with reflections of trees, for instance—shipping in motion, &c., we shall treat of in the chapter on instantaneous work.

We will suppose our pupil has determined on some locality where he is sure to find subjects such as those we have described. We shall follow him, indicating how he should act as he proceeds. First, he has to fill his slides. We will suppose he has three of these; they must be packed into a case which should be made to hold them and the camera. Besides these, he must take his lens, his tripod—and let him be most careful not to leave the screw behind him—his focussing cloth, and possibly a "focussing magnifier." This is a small eye-piece to magnify the ground glass image, and enable him to

focus with precision. It is useful mostly because it increases the light. When a small stop is used the ground glass image is frequently so dull that it can barely be seen.

Arrived at the scene of action, the photographer must select his point of view most carefully. Let him be in no hurry; frequently a picture will be made or spoiled by altering by a few yards the position of the camera. When he has quite made up his mind, let him unfold his camera, erect it, and place it before the scene to be depicted.

A few words on the management of the tripod stand. With the beginner this is apt to prove most wonderful and fearful in its movements. The effect of moving any one leg appears to be the exact opposite of what might have been reasonably expected. After long struggles the whole apparatus assumes an appearance of hopeless intoxication, and finally collapses, very possibly pinching severely the tyro's fingers between the tail-board and one leg. Let the stand be, however, once for all placed on the ground with its three legs about equally far, and a good distance, apart, and with one of them pointing to the scene to be photographed, and all trouble will cease. There will be room for the photographer to focus comfortably standing between the back legs. To tip the camera up, all that is necessary is to draw the forward leg towards him; to tip it down, he need only push it from him. He may still further tip it up by spreading the back legs apart; and down by bringing them together. He may turn it slightly to one side or the other by swivelling it on the screw, without moving the stand.

When the camera is fixed, and the view focussed, it will probably be found that there is too much foreground, and too little sky. Now, one of two things may be done. The camera may be "tipped" up. In this case, if there be any parallel vertical lines in the

picture, they will be made to converge towards the top, and it will be necessary to bring the swing-back into play, so as to make the ground glass once more vertical. If there be no vertical parallel lines, the camera may be tipped a little without appreciably modifying the result. The camera front and lens may be raised. This is usually the best course to adopt. The use of a swing-back always *strains*, so to speak, the lens, and necessitates the use of a very small stop. Raising the lens also strains it, but to a less degree. Tipping the camera does not. Most cameras are made so that either a vertical or horizontal picture can be taken, and judgment must be used to determine in which position it shall be. All the points above indicated having been considered, and the picture being all on the ground glass—proceedings so far having been conducted with open aperture or a large stop—the final focussing must be done. The principal object—generally, as before remarked, in the middle distance—must be made absolutely sharp. Then stops smaller and smaller must be tried till the distance is *just* sharp.

Now all is ready for exposure. Let plate No. 1 be exposed first, and on no account let any plates be exposed other than in their correct order, else the photographer will be likely to expose two views on the same plate. A much more aggravating thing he cannot do. In exposing, procedure is exactly as described in a former chapter. We give further on a set of tables, from which may be learned, as accurately as it is possible to tell, the exposure which it is necessary to give.

We should say that, for a landscape, the most pleasing lighting is usually a side-lighting. The lighting looking towards the sun is sometimes very pleasing, but care must be taken not to include the sun itself. This must be either to one side of or above the picture, or may be kept out of it by the camera being placed in the shadow of a tree or some such object.

CHAPTER VIII.

INSTANTANEOUS PHOTOGRAPHY.

ALTHOUGH "instantaneous" photography was practised to a certain extent before the advent of gelatine dry plates, the difficulties in the way of success were so great that only a few of the most skilled ventured to attempt it. Now all is changed. So easy is it to take what are called instantaneous views that there is no reason why such should not be included among the attempts even of the beginner.

The term instantaneous is a most indefinite one, and one which might with advantage be disused, could a better be found. It means, of course, a very short space of time, and, with regard to photography, is, we may state, commonly used to designate an exposure varying from about half a second to a very much briefer period of time, for the subjects which the landscape photographer is likely to attempt, say to a fiftieth of a second. Much shorter exposures than these have been used for special purposes, but the results, however curious or scientifically useful they may be, are not artistic.

As regards the subjects most suitable for instan-

taneous work, we may say a few words. Of all such, sea scenes come first. Effects of sea and cloud alone often make charming pictures, with the addition of ships in motion even more so; river scenes are also well rendered. Much more difficult, and usually much less successful as pictures, are subjects including crowds of people. For such, the exposures must be longer, the lens must be more rapid, or the plates must be more sensitive than for subjects of the nature of those first mentioned. Nevertheless, many wonderful representations of crowds on the sands of the sea-shore, in the streets, and so forth, and even representations of horse races with their thousands of eager spectators, have been produced.

For the shorter exposures mentioned it is evident that a mechanical instrument is required. There are many such, but all are classed under the title "instantaneous shutters."

For the first subject mentioned, however—namely, sea and sky, without moving shipping, or with only such as is in the distance, or is moving but slowly—an instantaneous shutter is by no means necessary, as a comparatively prolonged exposure may be given.

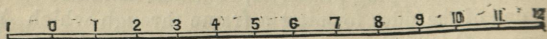
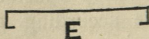
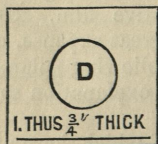
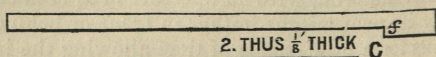
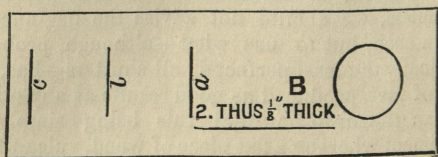
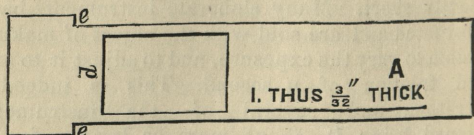
It is quite possible to give by hand, with a little practice, using the common cap, an exposure as short as a fourth or a fifth of a second. This is quite short enough for the effects which we are just now considering. The cap is rapidly lifted upwards to an inch or two above the lens, then quickly re-adjusted. It is evident that in this manner a somewhat longer exposure will be given to the sea than to the sky, but this is an advantage rather than otherwise.

If ships or boats in rapid motion are to be included in the picture, or if men or animals in motion are to be attempted, an instantaneous shutter giving a short

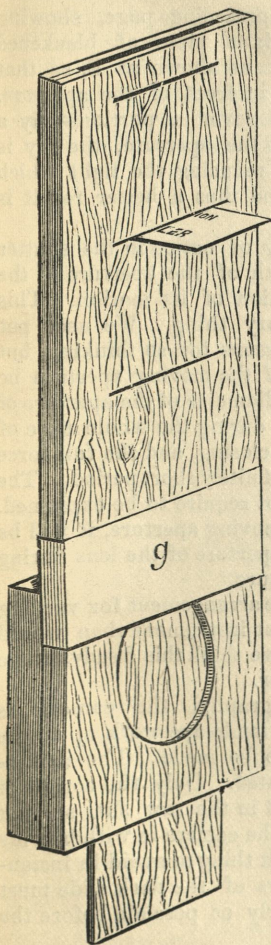
exposure is necessary, the aperture of the lens being increased to a corresponding degree. For almost any subject which is capable of forming a picture, an exposure of a tenth or a fifteenth of a second is sufficiently short. Many elaborate instruments have been invented and are sold with the object of making it possible to vary the exposure, and to adjust it to any desired fraction of a second. This is indeed a desideratum, and several of the instruments mentioned bring it about more or less perfectly. Nevertheless, we should not advise the beginner to invest in such, but to use what—although, probably theoretically the least perfect of all shutters—has, as a matter of fact, produced as good results as any other: we mean the drop shutter; this being simply an arrangement whereby a flat piece of wood, vulcanite, or other such material, with an aperture in it, is caused to drop by its own weight, either in front or behind the lens, thus for a brief space of time allowing the image to impress itself on the sensitive film. He may purchase a drop shutter at no great expense, or may make one according to the following plan. The sketches given scarcely require explanation so far as construction is concerned.

A is the dropping piece; B, of which there are two, is one of the sides forming a frame through which A drops; C is a distance piece, of which, again, there are two to keep the two B's apart; D is a thick piece of wood, in which there is a hole accurately cut to the size of the hood of the lens, so that it may support the whole. The arrangement is shown complete on the next page. Any hard wood forms a suitable material out of which to construct the instrument. The pieces B may, with advantage, be of vulcanite; A is better of wood. If it be made of vulcanite, there must be allowed considerably

greater width at each side of the aperture, or the drop is likely to snap the moving piece in two. The frame should be put together with glue, and when this has dried, screws should be used to strengthen the whole.



And now for the action of the arrangement. Of course, it is understood that A slides easily and without friction between the two pieces B. Indeed, it should drop almost without touching them; *a*, *b*, and *c* are saw slits through both pieces B. They form a trigger arrangement, and also an arrangement whereby it is possible to give a variable exposure. Focussing is performed with the piece A, entirely removed from the shutter. It is then inserted, a small piece of cardboard,



such as a common calling card, being placed in one of the slits *a*, *b*, and *c*, so that the dropping piece supports itself on *d*. If a comparatively long exposure is required, the card is put in the slit *a*; if a short one, in the slit *c*; whilst for a medium exposure *b* is used. The reason of the variation is not far to seek. The velocity of a falling body is, as we all know, uniformly accelerating. It is evident, then, that if the moving part have been allowed to fall for a certain distance, it will fall more rapidly across the aperture than if the exposure commenced with the falling. The fall is arrested by the projections *e*, *e*, coming into contact with those *f*. A shutter made to the size given is suitable for a lens with a hood $1\frac{1}{4}$ to $1\frac{1}{2}$ inches diameter. It will do well for a lens of the rapid symmetrical or rapid rectilinear type, suitable for plates $6\frac{1}{2}$ by $4\frac{3}{4}$. The lengths of the three different exposures given by it are approximately 1-8th, 1-12th, and 1-16th second.

In the sketch on the preceding page, showing the shutter complete, *g* is a piece of blackened tin or ferrotype plate, bent as shown at E, so that it may slide up and down in front of the aperture. By adjusting it, so as to cover a portion—say a third—of the upper part of the aperture, the sky is somewhat shaded, without reducing the light which the foreground receives, and thus a better result is obtained.

The feature most worthy of notice in the shutter described is the great length of the aperture of the dropping piece in the direction of its motion. This we consider a most necessary thing. We need not enter in detail into our reasons for so thinking, but will merely point out that if the moving aperture be only the same length as the diameter of the aperture of the lens, the instrument is, during the whole time of exposure, either opening or closing, and the full force of the light only acts for an infinitely short period. The disadvantage of this does not require to be explained. In the shutter with a long moving aperture, it will be seen that there is the clear aperture of the lens during the greater part of the exposure.

The long aperture, and the arrangement for varying the exposure, involve a larger instrument than would otherwise be necessary, but we think this disadvantage is more than compensated for.

In instantaneous photography, the camera is manipulated as for ordinary landscape work up to the time when the exposure is to be made. The instantaneous shutter is then adjusted. Only the corner of the card should be inserted in the saw slit, so that there may be no shaking of the camera in withdrawing it, this being the most difficult thing to avoid in instantaneous work. The shutters of the dark slide must not be withdrawn till as nearly as possible before the

exposure is made. The effect desired is watched for. Nervousness and hurry must be avoided, though it is difficult. It is much more common to expose just too soon, than just too late. When the exact moment has arrived, the card is gently withdrawn, and the plate receives the actinic impression.

CHAPTER IX.

PORTRAITURE.

To take portraits—secure likenesses of his friends—is sure to be an early ambition of the photographer. In fact, he will show self-denial above the average in foregoing his natural desire if his first attempt be not to “perpetrate a portrait.” Nor is this to be wondered at, for, indeed, there is a charm in portraying the human face and form, quite other and much greater than there is in making pictures, ever so truthful and beautiful, of trees and things without life. Nor need the amateur despair, now that he has at his command the wonderful powers of the dry plate, of reaching a certain proficiency. True, in this department of photography he need not, as in landscape work, aspire to compete with the professional, other than the third or fourth-rate one; still, a portrait done by a friend is sometimes looked upon in a kindly spirit by the original, and valued for the sake of the portrayer. In one point the amateur has an advantage: the surroundings and operations are not likely to create the awe and nervousness which appear to overcome some sitters whenever they enter the formidable studio of the professional.

Portraits may be done either out of doors or in an ordinary room. We put on one side the possibility of the amateur having command of a studio.

Out-of-door portraiture calls for little remark. It is comparatively easy; but the results gained are not usually so pleasing as those of successful in-door work.

All that is necessary is to get a suitable place in which to operate. There must be some means of shutting off a portion of the top light. This may often be secured by taking advantage of the outspreading branches of a tree. The position chosen must be such that there will be a somewhat stronger light on one side of the sitter than on the other; by this means there are secured relief and roundness. If a full-length sitting or standing figure be attempted, a natural background, such as an ivy-covered wall, the stem of a large tree, or such like, is the best. If heads be done, an artificial background, such as will be described hereafter, should generally be used.

The requirements for portraiture indoors are more complex. The chief of these is a head-rest. This is an instrument much abused by many; and indeed, one which it would be good to do away with; but which, in the present condition of photographic knowledge, is still, in most cases, a necessity. The average sitter is unable to keep sufficiently steady without a rest for his head, and for his body, if he be standing during an exposure of longer than four or five seconds. Now, on consulting the tables given farther on, it will be seen that in a common room an exposure so short as this is secured only with the rapider forms of portrait lenses used with full aperture. If a larger size than the carte be attempted, it will generally be found that so large apertures cannot be used, even if the lenses be at hand, because the depth of focus given thereby is so small. It is true that, if a room with a very large window be

available, the exposures during bright weather may be reduced to one-half those given. In this case, the head-rest may be dispensed with for most sitters. As regards lens, that known as the group, or D lens, or one of the rapid symmetrical or rapid rectilinear, is most suitable, unless the amateur possesses a portrait combination. Even the "single lens," if the aperture be increased to "8" (see tables, pages 65, 66, 67), may be used; but the exposure will be somewhat prolonged.

One thing to be particularly mentioned in connection with the lens used for portraiture, either in-doors or out: *it must be one of long focus*, otherwise the most unpleasant effects of exaggerated feet, hands (or in large heads, nose)—in fact, all the parts nearest the camera—will be the result. The focal length of the lens should be at least double the larger dimension of the portrait to be produced. Thus, for a carte, it should not be less than $7\frac{1}{2}$; for a cabinet, not less than 12 inches.

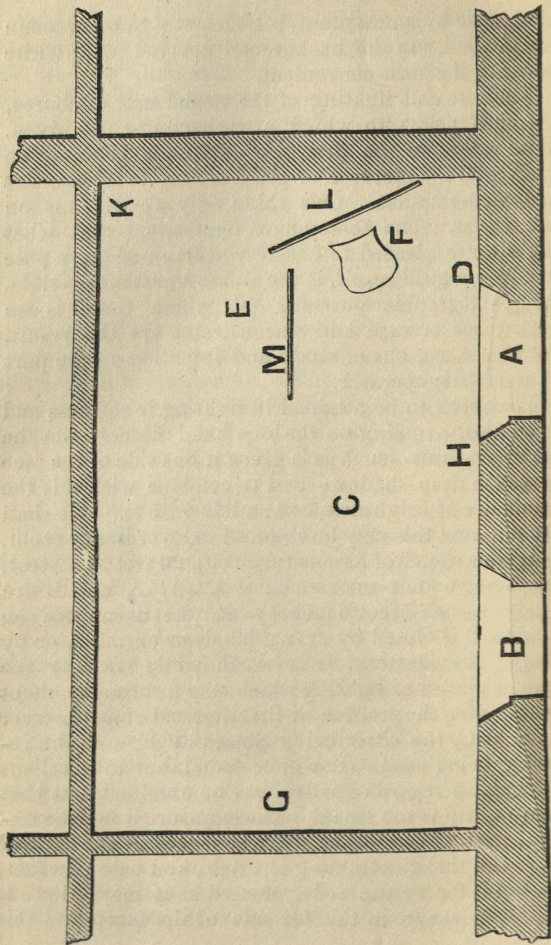
A background of some sort is a necessity. Sometimes the walls of a room are suitable; but generally it is best to construct a special background. This may be done by making a light frame-work of wood, 7 feet by 5 feet, and stretching on it the coarse brown paper known as "carpet paper." This is done by damping the paper, so as to stretch it, then gluing it on to the frame by the edges. Paper may be thus stretched with advantage on both sides of the frame; one side may be left the natural colour of the paper, and will do for dark backgrounds; the other may be painted of a light grey colour with "distemper," and will serve as a light background for heads to be "vignetted."

A reflector is a necessity for in-door portraiture. Its use is to relieve the heavy shadows on the side of the face which is away from the light. A sheet or table-

cloth, held by an assistant, is sufficient ; but a wooden frame, similar to the background covered with white paper, is the most convenient.

The pose and lighting of the model are, of course, the chief points to which attention must be given. With regard to the first, we advise the beginner to study well the pictures of good artists, both painters and photographers. One thing only we will say on the matter. The so-common impressions that what the sitter is pleased to consider a free and easy pose will give a good result, is the greatest mistake possible. All photographic portraits in which there is an appearance of ease and unconstraint are the result, not of chance, but of study and intention on the part of an artistic operator.

The object to be attained in lighting is softness and roundness, avoiding on the one hand flatness, on the other harshness—such as is given if one side of the face be in too deep shadow—and to combine with this the maximum of brightness compatible with it. We shall explain how this may be obtained in an ordinary room. We give a sketch of a room (page 56), 20 feet by 12 feet, this being a not uncommon size. At A and B are windows, each 3 feet 6 inches wide. Let us suppose the window B is closed by drawn blinds or curtains, or by closing the shutters ; it is worth while noticing the various phases of lighting which may be brought about by changing the position of the sitter. Let an observer stand at C, the sitter being placed at E, and the reflector being used. It will be found that an excellent lighting, as regards quality, can be obtained, but that the quantity is too small. The exposure would be extravagant. Now let the sitter be placed at D. It will be found that the lighting is bright and bold ; in fact, too bold, for be the reflector used as it may, there is too deep shade in the far side of the face, and this



will be even more apparent in a photograph than to the eye. A compromise must evidently be brought about. This may be done by placing the sitter at F. It will now be found that the lighting will be all that can be desired, whilst the exposure will not be much greater than with the model at D.

The spot where a soft and harmonious lighting is secured being determined, the next question is from what direction is the portrait to be taken? For pleasing results may be got with anything between three-quarters light, one quarter shadow, and one-quarter light, three-quarters shadow, the latter style of lighting having been given the name of Rembrandt. With a room of the shape and size shown, the choice is not great for full-length standing figures, as the camera will have to be kept far from the sitter, and towards the end of the room. With heads, however—in which particular form of portrait the lighting is, if possible, more all-important than in any other—the camera may have its position varied anywhere from H to K. Probably the most successful results will be got from H. If the position be approached to K with the object of getting “Rembrandt” effects, means must be taken to shade the direct light from the window off the lens. The background, L, and the reflector, M, are shown in position for a sitter at F, and for the camera about H. It is unnecessary to say that the reflector must be kept far enough away not to appear in the picture. It should, however, short of this, be kept as near as possible.

After posing, the head-rest should be adjusted. It must be distinctly understood that this appliance is not meant as a means of clamping up the model's head, but that it is intended as a rest to be brought into position after posing has been performed, so that the sitter may gently lean his head against it.

The reason for advising that one of the windows be closed is, that a double source of light is objectionable. It is liable to produce an unpleasant lighting in general, and almost always causes a false light in the eyes.

With regard to the taking of groups, our advice is to follow as closely as possible that given by *Punch* to young men about to marry—"Don't." An amateur seldom acquires the skill necessary to enable him to pose and light artistically one figure with any degree of certainty. It is enormously more difficult when there are several. If groups must be done, they are best done out of doors. Except for carte size, a lens with comparatively small aperture must be used for groups, so as to get all the figures in focus. This makes the exposure very prolonged in an ordinary room. Moreover, some of the figures must in such a case be much nearer the light than others.

In grouping out of doors, the figures near the end of the group should be brought somewhat nearer the camera than the others, as this will bring them into better focus. Several may, with advantage, sit down slightly in advance of those standing. If the photographer can prevent all the members of the group from gazing into the camera with a glassy stare, and cause them to turn towards each other as if in conversation, he will have accomplished much.

CHAPTER X.

TABLES TO FACILITATE JUDGMENT OF EXPOSURE.

WE gave, in the chapter on lenses, rules whereby it is possible to compare the rapidity of various lenses, and having once determined for a certain subject the exposure for any one lens and stop, to estimate exactly what would be the exposure with any other lens and stop. The work involved is little and easy, but there are some who find even such difficult. For the sake of these we have compiled a set of tables which we believe make it as impossible to find any difficulty in estimating exposures as can be. We shall explain the use of them.

The Photographic Society of Great Britain has established a standard of rapidity for lenses. A lens with an aperture one quarter its focal length ($\frac{f}{4}$) has been taken as the unit, and is called "1." A stop of half the area, which will necessitate double the exposure, is called "2;" one requiring double the exposure of this latter again is called "4;" and so on, 8, 16, 32, 64, 128, 256, this last being about the smallest aperture ever used in practice. Apertures larger than $\frac{1}{4}$ the focal length—which are rare—are signified by .5, .25. The latter is the largest aperture possible to get in practice.

Now it is evident that if all opticians were to adopt this standard, the estimation of exposures would be much simplified. Every stop would have on it a number signifying the rapidity of the lens when it was in use, and the same number would signify the same rapidity in the case of any lens. Moreover, the effect of using a stop one size smaller than another would always be to double the exposure.

We do not know whether the manufacturing opticians have adopted the suggestion of the Photographic Society, but whether they have or not, the greater number of lenses in the market have not their stops adjusted in accordance with it. It is often, however, easy to alter stops so as to accord with the standard. To enable any photographer to do so who wishes, we give a table showing for any focal length of lens what are the diameters to which it is necessary to cut the stops. Referring to Table I., we find, for example, that with a lens of 9 inches focal length the aperture "1" will be 2.25 inches, that is, two and a-quarter inches. It is only possible to get such an aperture with a portrait lens, and if the lens in question be not such, we must pass on to "2;" here we find 1.59 inches—still only possible with a portrait lens. "4" we find is 1.12. This is a possible aperture with what are known as group lenses; the next, "8," is .80 inches, and is an aperture to be had in all lenses of the rapid rectilinear or rapid symmetrical type. "16" is .56 inches, and may be had in "single" lenses of modern patterns; "32" is .40, and may be had in any single lens; "64" is .28 inch; 128 is .20 inch; and 256 is .141 inch.

In the case of a portrait lens, we should thus make our largest aperture $2\frac{1}{4}$ inches, and call it "1" (unless, that is, we were able to get an aperture of 3.18 inch, which we should call .5), and the others 1.95 inches, 1.12, and so on, down as small as we pleased. In the case of a group lens, our largest stop would be 1.12, or,

say, $1\frac{1}{2}$ inch. We would, however, not call this "1," because it is the first stop of this particular lens in question, but "4," because the aperture is $\frac{1}{8}$. In a single lens our largest would be .56 inches, and would be marked 16.

For any lens whose focal length is *half* that of one given in the table, the apertures must be divided by two. For one with twice the focal length of any mentioned, they must be *multiplied* by two, for three times by three, and so forth. It is thus possible, by mere reference to the Table I., to cut a set of stops to the standard sizes for any lens.

We now take Table II. This requires no great explanation. In it will be found the necessary exposures for most subjects with all standard apertures of the Photographic Society.

Table III. is not quite so readily understood. We have explained how to cut a set of stops to the standard sizes for any lens, but it is quite possible that some may not have the inclination to, or the means of doing so. For such this table is intended. We can by its use take any lens, and by merely measuring the stops, and referring to the table, say to which standard aperture each stop most nearly approaches.

We shall take an example. We shall suppose once more that we have a portrait lens of nine inches focal length, and that we do not wish to make a new set of stops, but that we wish to find out for each of the stops which we have got with the lens, to which of the standard numbers it most nearly approaches. Say the full aperture of the lens is $2\frac{1}{2}$ inches, and the other stops 2 inches, $1\frac{1}{2}$ inch, 1 inch, and $\frac{1}{2}$ inch. On the table, opposite 9 inches focus and $2\frac{1}{2}$ inch aperture, we find "1," that is to say, 1 is the standard number to which the lens working full aperture is nearest. Opposite 2 inches, we find still "1;" opposite $1\frac{1}{2}$ inches we find "2;" opposite 1 inch, "4;" and opposite $\frac{1}{2}$ inch, "16." One

thing is to be noticed: after each of these figures there is to be found a “+” or “—” sign. The first means that the aperture is somewhat larger than the standard aperture along with which the sign is, the second that it is somewhat smaller. Thus, with the nine-inch focus lens which we are considering, $2\frac{1}{2}$ inches is somewhat larger than “1,” and therefore the exposure somewhat shorter; 2 inches is somewhat smaller, and the exposure with it consequently a little longer.

We shall now explain the working of Tables III. and II. together, by taking a set of examples.

Let us suppose we have a single landscape lens of 8 inches focus, that the subject we are about to photograph is a landscape with deep shadows and dark foreground, and that the stop used is to be $\frac{1}{4}$ inch diameter. In Table III. we find opposite 8-inch focus and $\frac{1}{4}$ -inch aperture, “64.” We now turn to Table II. Opposite “64” (or $\frac{f}{32}$) we find, for landscape with heavy foliage in the foreground, 8 seconds. This, therefore, is the exposure required. Again, let us suppose the lens and subject the same, but the aperture used only $\frac{3}{16}$ th inch. We find opposite $\frac{3}{16}$ th inch in Table III. “ $\frac{32}{+}$,” that is to say, aperture is somewhat over “32.” Opposite 32 inch, Table II., we find 16 seconds; but as the aperture is on the large side, the exposure must be on the short side. We must therefore make it, say, 14 seconds.

Yet another example. Suppose a “rapid” view lens, focus 10 inch, stop $\frac{7}{8}$ inch, the subject a portrait out of doors. In Table III. we do not find $\frac{7}{8}$ inch among apertures. Let us therefore take $\frac{3}{4}$ inch and 1 inch, that is, the figures on each side of what we require. We find under $\frac{3}{4}$ inch $\frac{8}{-}$, under 1 inch $\frac{8}{+}$; that is to say, $\frac{3}{4}$ inch is somewhat less than “8,” 1 inch somewhat more than “8.” We may therefore assume $\frac{7}{8}$ to be practically equal to “8.” In Table II. we find opposite “8,” for a portrait out of doors, 2 seconds; this, therefore, is the exposure required.

Another thing we must mention. In case of portraits, when large heads are done, the camera has to be drawn out to a considerable distance, possibly several inches. The focallength of the lens is, in fact, increased for the particular subject. This has to be taken into account in judging of the exposure.

We shall take an example of this. Let us suppose a 12-inch focus portrait lens used with an aperture of two inches, the subject being a portrait indoors. We find that this aperture is, according to Table III., $\frac{2}{2}$, or somewhat less than 2. The exposure, according to Table II., will be therefore somewhat more than 6 seconds, say 7 or 8 seconds. Let us suppose, however, a head one-third life size to be attempted. It will be found that the camera must be extended till the focus of the lens is 16 inches. Referring to Table III., we find that this means " $\frac{4}{4}$," and referring to Table II. we find that the exposure must be protracted to 12 seconds.

It must be understood that Table II. is only approximate. Thus plates vary considerably in sensitiveness. The rapidest plates of which we have had experience will, however, not be spoiled by exposure of half those given, whilst the slowest commercial plates sold as "rapid or instantaneous" will not require more than twice those given. Again, as to subject. Very often subjects do not come precisely under the headings given. For example, landscapes most often come somewhere between such as are described in the second and third columns. By an open landscape is meant such subjects as show broad exposures of sunlight without any deep shadows near the camera. River scenes with trees in the distance, roads and houses without trees, and such like, come under the heading.

By the "interiors" is meant such subjects as cathedrals and churches. They require very careful treatment, as there is likely to be a greater range of light than can well be registered by a photographic film.

With regard to "portraits in ordinary rooms," we explained that under the most propitious circumstances the exposures may be reduced to half those given, which are on the consumption of an average sized window, without houses or trees opposite it. If there be opposite the window anything to obscure much of sky, the exposures will have to be greatly protracted.

The time of year is supposed to be that most propitious for photography—namely, spring or early summer, the weather bright and clear; the time of day either morning or noon. In the country, the latter part of summer, and even the early part of autumn, afford nearly as good light as spring, but it is not so in large towns. In even the best light of winter, the exposures must be several times those given. The same is the case after three or four in the afternoon of the best spring and summer months. No rule can be given for exposures in dull and foggy weather, but it may be said that they require to be much more protracted for such, than the beginner would at first imagine.

TABLE I.

Focal Length	6 ins.	6½ ins.	7 ins.	7½ ins.	8 ins.	8½ ins.	9 ins.	9½ ins.	10 ins.	11 ins.
Standard No.										
.25	3	3.25	3.5	3.75	4	4.25	4.5	4.75	5	5.5
.5	2.12	2.3	2.47	2.65	2.82	3.01	3.18	3.36	3.53	3.89
1	1.5	1.62	1.75	1.87	2	2.12	2.25	2.37	2.5	2.75
2	1.06	1.15	1.23	1.32	1.41	1.50	1.59	1.68	1.77	1.94
4	.75	.81	.87	.93	1	1.06	1.12	1.18	1.25	1.37
8	.53	.57	.62	.66	.71	.75	.80	.84	.88	.97
16	.37	.40	.44	.47	.5	.53	.56	.59	.62	.69
32	.26	.28	.31	.33	.35	.38	.40	.42	.44	.49
64	.188	.20	.22	.23	.25	.26	.28	.29	.31	.34
128	.132	.144	.155	.168	.177	.188	.20	.21	.22	.24
256	.094	.101	.109	.117	.125	.133	.141	.148	.156	.172

TABLE II.

Apertures calculated on the Standard System of the Photographic Society	Sea and Sky.	Open Landscape	Landscape with Heavy Foliage in the Fore- ground	Under Trees, up to	Fairly Lighted Interiors	Badly Lighted Interiors up to	Portraits in Bright Diffused Light out of doors	Portraits in Ordinary Rooms
·25, or $\frac{f}{2}$...	$\frac{1}{640}$	$\frac{1}{240}$	$\frac{1}{32}$	mins. 0 secs. $2\frac{1}{2}$	mins. 0 secs. $2\frac{1}{2}$	hrs. 0 mins. $\frac{1}{2}$	secs. $\frac{1}{16}$	mins. 0 secs. $\frac{3}{4}$
·5, or $\frac{f}{2.828}$...	$\frac{1}{320}$	$\frac{1}{120}$	$\frac{1}{16}$	0 5	0 5	0 1	$\frac{1}{8}$	0 $1\frac{1}{2}$
1, or $\frac{f}{4}$...	$\frac{1}{160}$	$\frac{1}{60}$	$\frac{1}{8}$	0 10	0 10	0 2	$\frac{1}{4}$	0 3
2, or $\frac{f}{5.657}$...	$\frac{1}{80}$	$\frac{1}{30}$	$\frac{1}{4}$	0 20	0 20	0 4	$\frac{1}{2}$	0 6
4, or $\frac{f}{8}$...	$\frac{1}{40}$	$\frac{1}{15}$	$\frac{1}{2}$	0 40	0 40	0 8	1	0 12
8, or $\frac{f}{11.314}$...	$\frac{1}{20}$	$\frac{1}{8}$	1	1 20	1 20	0 16	2	0 24
16, or $\frac{f}{16}$...	$\frac{1}{10}$	$\frac{1}{4}$	2	2 40	2 40	0 32	4	0 48
32, or $\frac{f}{22.627}$...	$\frac{1}{5}$	$\frac{1}{2}$	4	5 20	5 20	1 4	8	1 36
64, or $\frac{f}{32}$...	$\frac{2}{5}$	1	8	10 40	10 40	2 8	16	3 12
128, or $\frac{f}{44.723}$...	$\frac{4}{5}$	2	16	21 0	21 0	4 16	32	6 24
256, or $\frac{f}{64}$...	$1\frac{1}{2}$	4	32	42 0	42 0	8 32	64	12 48

A, portrait lenses; B, rapid view lenses; C, landscape lenses.

Apert.	1-16	3-32	1-8	3-16	8	3-8	1-4	1-2	1-1	1-1/2	1-3/4	1-1/8	1-1/16	1-1/32	1-1/64	1-1/128	1-1/256	1-1/512	1-1/1024	1-1/2048	1-1/4096	1-1/8192	1-1/16384	1-1/32768	1-1/65536	1-1/131072	1-1/262144	1-1/524288	1-1/1048576	1-1/2097152	1-1/4194304	1-1/8388608	1-1/16777216	1-1/33554432	1-1/67108864	1-1/134217728	1-1/268435456	1-1/536870912	1-1/1073741824	1-1/2147483648	1-1/4294967296	1-1/8589934592	1-1/17179869184	1-1/34359738368	1-1/68719476736	1-1/137438953472	1-1/274877906944	1-1/549755813888	1-1/1099511627776	1-1/2199023255552	1-1/4398046511104	1-1/8796093022208	1-1/17592186044416	1-1/35184372088832	1-1/70368744177664	1-1/140737488355328	1-1/281474976710656	1-1/562949953421312	1-1/1125899906842624	1-1/2251799813685248	1-1/4503599627370496	1-1/9007199254740992	1-1/18014398509481984	1-1/36028797018963968	1-1/72057594037927936	1-1/144115188075855872	1-1/288230376151711744	1-1/576460752303423488	1-1/1152921504606846976	1-1/2305843009213693952	1-1/4611686018427387904	1-1/9223372036854775808	1-1/18446744073709551616	1-1/36893488147419103232	1-1/73786976294838206464	1-1/147573952589676412928	1-1/295147905179352825856	1-1/590295810358705651712	1-1/1180591620717411303424	1-1/2361183241434822606848	1-1/4722366482869645213696	1-1/9444732965739290427392	1-1/18889465931478580854784	1-1/37778931862957161709568	1-1/75557863725914323419136	1-1/151115727451828646838272	1-1/302231454903657293676544	1-1/604462909807314587353088	1-1/1208925819614629174706176	1-1/2417851639229258349412352	1-1/4835703278458516698824704	1-1/9671406556917033397649408	1-1/19342813113834066795298816	1-1/38685626227668133590597632	1-1/77371252455336267181195264	1-1/154742504910672534362390528	1-1/309485009821345068724781056	1-1/618970019642690137449562112	1-1/1237940039285380274899124224	1-1/2475880078570760549798248448	1-1/4951760157141521099596496896	1-1/9903520314283042199192993792	1-1/19807040628566084398385987584	1-1/39614081257132168796771975168	1-1/79228162514264337593543950336	1-1/158456325028528675187087900672	1-1/316912650057057350374175801344	1-1/633825300114114700748351602688	1-1/1267650600228229401496703205376	1-1/2535301200456458802993406410752	1-1/5070602400912917605986812821504	1-1/10141204801825835211973625643008	1-1/20282409603651670423947251286016	1-1/40564819207303340847894502572032	1-1/81129638414606681695789005144064	1-1/162259276829213363391578010288128	1-1/324518553658426726783156020576256	1-1/649037107316853453566312041152512	1-1/1298074214633706907132624082305024	1-1/2596148429267413814265248164610048	1-1/5192296858534827628530496329220096	1-1/10384593717069655257060992658440192	1-1/20769187434139310514121985316880384	1-1/41538374868278621028243970633760768	1-1/83076749736557242056487941267521536	1-1/166153499473114484112975882535043072	1-1/332306998946228968225951765070086144	1-1/664613997892457936451903530140172288	1-1/1329227995784915872903807060280344576	1-1/2658455991569831745807614120560689152	1-1/5316911983139663491615228241121378304	1-1/10633823966279326983230456482242756608	1-1/21267647932558653966460912964485513216	1-1/42535295865117307932921825928971026432	1-1/85070591730234615865843651857942052864	1-1/170141183460469231731687303715884105728	1-1/340282366920938463463374607431768211456	1-1/680564733841876926926749214863536422912	1-1/1361129467683753853853498429727072845824	1-1/2722258935367507707706996859454145691648	1-1/544451787
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CHAPTER XI.

SECOND LESSON IN DEVELOPMENT.

IN our last lesson on development, we considered the ferrous oxalate developer only, this being, as we have said, the best for a beginner. There are some who prefer it to any other, even after long experience; but the vast majority of English photographers find qualities in the so-called "alkaline pyrogallie" developer which seem to be wanting in the other. The most notable of these is the power to compensate for a certain error in exposure.

In considering the subject of exposure in a former chapter, we assumed that correct exposure is a fixed point, and that any deviation from it would give imperfect results. This is scarcely the case, however, for there is a certain "latitude," which is due to two causes: first, a certain latitude of *effect* is permissible. Thus, if the plate be a little under-exposed, there will be somewhat less detail in the resulting picture than is visible to the eye, but this need not spoil it. Again, if the plate be somewhat over-exposed, the effect will be a slight fog or want of transparency in the shadows of the negative; but the only result of this will be that what is called a "slow printing negative"

will be produced. The latitude in effect is not great, however. It may be said that if two seconds be the best exposure, anything between one and a-half and four seconds will give good results. We have, however, a second method of gaining latitude, and this is by means of the treatment with the developing solutions. Thus, with any developer, simply by leaving the plate for a longer or shorter time in the solution, we can compensate to a certain extent for under or over-exposure. It is, however, by varying the proportions of the ingredients of the alkaline developer that we gain the greatest latitude. We must describe the developer, enumerating its constituents, and describing the functions of each of them.

The essentials are as follows:—First, pyrogallie acid, or more properly, pyrogallol; second, liquid ammonia, or occasionally some other alkali; third, a soluble bromide, usually bromide of ammonium or of potassium.

These three chemicals are dissolved in certain proportions in water, and the result is the alkaline pyrogallie developer. This is used precisely as the ferrous oxalate is; that is to say, the liquid is poured over the plate, when the image begins to appear, development being watched exactly in the same manner in each case. As usually mixed, the alkaline developer performs its functions more quickly than does the ferrous oxalate, but this is not the case with all plates.

The pyrogallie is the true developer, and acts very energetically when rendered alkaline. The stronger the developer is in pyrogallie, the denser or more opaque will be the negative; and, as a consequence, the stronger will be the contrast between light and shade in the resulting print.

The ammonia is used to render the developer alkaline, and the greater the quantity in the solution, the more energetic the action. The effect of increasing the ammonia is to shorten greatly the time of development,

to increase to a slight extent the amount of detail, and to increase the density. A point is reached, however, where the action is so energetic as to reduce or blacken even those parts of the plate which have not been acted on by light, and fog is the result. Some plates will stand much more ammonia than others.

The use of the bromide is to retard development—to make it slower, so that it may be more under control. Without it the development is very rapid, and unless the quantity of ammonia be very small, it is difficult to avoid fog. The result of increasing the bromide is to make the developer much slower, to keep back a little of the detail, and to increase ultimate density greatly.

A little consideration of what we have said will show that by varying the proportions of the constituents we have enumerated, we have the power of greatly modifying the resulting negative, and have a power of compensating to a considerable extent for error in exposure. This is especially the case for over-exposure. It is true that in the case of under-exposure we can correct to a certain extent by using an increased quantity of ammonia; but the fog point is soon reached, and thus it is only slightly that we can correct in this direction. In the case of over-exposure, however, it is different; bromide may be increased indefinitely. By largely increasing the quantity of bromide the development is rendered slow as regards the appearance of detail, but less so as regards the increase of density. It is thus possible to stop the process in the case of an over-exposed plate before the shadows veil over, and yet to have a sufficiently dense negative.

We have said that it is right, in using any particular make of plates, to use the developer recommended in the "instructions;" but it is by no means necessary to mix the "stock solutions" exactly as directed. On analysing any of the sets of stock solutions given, it will be

found that they consist essentially of the three chemicals mentioned before, made up in solutions of certain strengths, and generally with some preservative, in the case of the pyrogallic solution, to prevent its turning brown by oxidation. In almost every case there is a most needless complication introduced, which makes considerable calculation necessary to find what quantity of each chemical really is in an ounce of the final developer. There can be no simpler plan than to mix three solutions, each containing ten per cent. of one of the three ingredients. The developer can then be made up in any proportion without trouble, and that given in any instructions can be used without the intervention of complicated formulæ.

We recommend that the solution be mixed in the following manner:—

Dissolve quarter of an ounce of citric acid in eight ounces of water. Add this to one ounce of pyro. Make the whole up to ten ounces, and label "Pyro. solution, ten per cent."

Take one ounce of bromide of ammonia and make up with water to ten ounces. Label "Bromide solution, ten per cent."

Take one ounce ammonia, strength .880, or two ounces of the ammonia diluted with an equal amount of water as recommended before, and make up with water to ten ounces. Label—"Ammonia ten per cent. solution."

There is no developer which is suitable for all subjects. Those given in instructions can only be taken as typical. If the photographer expects to excel, he must vary his developer to suit his subject. Thus, when the contrasts in the object to be photographed are very strong—say in the case of an interior with white columns and deep shadows—he must reduce the amount of pyro., or he will have a negative giving a "chalky" print.

If the contrasts are naturally weak, as is sometimes

the case in open landscape, he must increase the quantity of the pyro and bromide. If he knows that he has under-exposed, he must increase the ammonia. If he knows that he has over-exposed, he must increase the bromide.

The following we have found to be a good developer for general purposes :—

Pyro	...	...	from 1 to 2 grains
Ammonia...	...	...	2½ minims
Bromide	...	...	1 grain

To each ounce of developer.

This is a more restrained developer than is usually recommended. We find, however, that the increase of the bromide beyond that commonly used does not, in the case of most plates, necessitate an appreciable increase in exposure, whilst it gives a better quality of negative, and permits of a considerable latitude in exposure simply by allowing the plate to be a longer or shorter time in the developer.

We shall now tell how the best result can be got from a plate when there is uncertainty as to whether or not it has had the correct exposure.

A developer made as follows should be flowed over the plate :—

Pyro	...	1 to 2 grains according to subject		
Ammonia	...	...	...	1 minim
Bromide	...	...	...	1 ,,

To each ounce of developer.

This is a very slow developer, and even if the plate be much over-exposed, the image will not appear for some time. A little experience will enable the photographer to know, by the length of time which elapses between the time of pouring on the developer and the appearance of the image, whether the plate has been over-exposed, correctly exposed, or under-exposed. If the exposure appear to be correct, let one minim and

a-half of ammonia be added to bring the strength up to that recommended. If it appear to be over-exposed, let development proceed, or even, in an extreme case, add more bromide. If the image be very long of appearing, showing that there has been under-exposure, ammonia may be added to any amount short of that which will produce fog.

Good plates should stand ten minims of ammonia with one and a-half grains of bromide. The greater the quantity of bromide, the larger the amount of ammonia that may be used; but the quantity of ammonia permissible is not proportionate to the bromide used. Doubling the quantity of bromide will not permit double the quantity of ammonia to be added. It will be understood that a minim of fluid measure corresponds to a grain of weight, so that in using the ten per cent. solutions of pyro and bromide we have simply to take 10 minims for every grain which we wish.

With the ferrous oxalate developer, under-exposure and over-exposure may be corrected to a certain extent, but not so greatly as with the alkaline developer. The developer may be accelerated by the addition of any quantity up to ten minims of a 1 per cent. solution of hyposulphite of soda to each ounce of developer, or retarded by the increase of bromide.

It is commonly said that there is difficulty with gelatine plates in getting a sufficiently dense image. Such a difficulty results from ignorance of the principles of development. The secret of getting "plucky" negatives lies in using an alkaline developer strong in all the constituents, but specially so in bromide, and in giving, perhaps, a slightly longer exposure than might otherwise be thought necessary. The real difficulty lies in judging when the density is sufficient.

CHAPTER XII.

DEFECTS AND REMEDIES.

THE photographer is sure not to practise the gelatine dry plate process very long before he comes across some of the defects which are peculiar to it. We intend, therefore, to describe these as accurately as we can, and, where possible, to give a means of either preventing the occurrence of the objectionable phenomenon, or of curing it when it has made its appearance. When the error is of a kind due to the *preparation* of the plates, we shall not enter into the cause of it, but merely, where possible, indicate the cure.

General Fog.—This is probably the commonest of all faults with gelatine negatives. It consists of a veil over the whole plate, showing itself by want of transparency in the shadows. It may be so slight as to be imperceptible, except when the negative is laid face downwards on a sheet of white paper, and, in fact, almost always exists to this extent in gelatine negatives, or may be so dense as to make the time necessary to get a print be measured by days. It is due to one of two causes, which are usually indicated by the names *chemical fog*, and *light fog*.

The first arises from error in the preparation of the

plate. By it is meant that the sensitive film is in such a condition that the silver salt is reduced by the developer without light having acted upon it. In certain cases it may be cured by soaking the plates before exposure in a solution of three grains of bichromate of potash to each ounce of water, afterwards thoroughly washing them by allowing them to remain in running or frequently changed water for at least an hour, and then drying them, all operations being, of course, performed in the dark room.

To distinguish chemical fog from light fog, the best way is to develop an un-exposed plate, performing all the operations in total darkness. This is not difficult. If the plate be found to have darkened, the fog is chemical fog, or, what is practically the same thing to the photographer, light fog, brought about by the action of light on the emulsion whilst in the hands of the manufacturer.

With the well-restrained developer which we gave in the last chapter, chemical fog is less likely to make its appearance than in the case of the feebly-restrained developers usually recommended. The bromide in the developer may even be increased beyond that which we give, but this will necessitate a somewhat longer exposure. We may state that bromide of ammonia in the developer begins, in the case of most plates, to have an appreciable actual slowing effect when it is used in the proportion of one-third to one-half the quantity of strong ammonia used. When the bromide equals the ammonia, the slowing effect becomes very great.

Light fog is due to the action of light generally in one of three ways: first, on account of an unsafe light in the dark-room; secondly, on account of a defect in the camera or dark slide admitting light; and thirdly, on account of over-exposure.

When the fog is due to light in the camera, this will be recognised by the fact that the portions of the plates

covered by the wires or rebates of the dark slides remain free from fog. When this is the case, the camera must be carefully examined by removing the focussing screen, and looking for any of the smallest defects which might admit light, the camera being placed in direct sunshine, and the head of the observer being covered with the focussing-cloth. Light finding its way through defects in the slides generally shows itself in the form of streaks or lines. Should no defect be detected, it may be assumed that over-exposure is the cause of the fog, and a shorter must be tried.

If fog from unsafe light in the dark-room be suspected, place a plate in the dark slide, draw out one of the shutters half-way, and then lay the slide for five minutes on the table where the plates are changed and developed; then develop the plate. If one-half darkens, it shows that the light is not safe, and steps must be taken to render it so.

Green Fog.—This defect is always due to error in the manufacture of the plates. It generally makes its appearance only in the shadows of the negative. If the negative be looked at by reflected light, a black object being laid under it, the shadows will be seen to be bright green. On looking through the negative they may appear somewhat pink, or sometimes a sort of "muddy" colour. Green fog makes its appearance only with alkaline pyrogallic development, or, in the case of ferrous oxalate, only from impurity of the chemicals, and chiefly when the plate has been under-exposed, and development "forced."

A slight amount of green fog is not detrimental to the printing qualities of a negative; but if the defect shows itself in an aggravated form, the best means of preventing it is to resort to ferrous oxalate development. Captain Abney has recently given a means of curing plates afflicted with green fog after development. It consists of bleaching the negative with a solution of

ferrie bromide, oxalate, or chloride, and afterwards applying the ferrous oxalate developer. Full particulars of the method will be found in the PHOTOGRAPHIC NEWS for April 28, 1882.

Red fog seems to be an aggravated form of the last-mentioned disease. In appearance it is a deep red deposit showing itself by transmitted light in the shadows of the negative. It is rarely met with at the present time, although it was common in the early days of gelatine plates. It does not make its appearance in plates developed with ferrous oxalate. Probably Captain Abney's cure for green fog would correct this defect also.

Frilling consists in an expansion of the film to such an extent that it loses its adhesion to the glass, and "frills" off. The phenomenon begins at the edge of the plate, and spreads towards the centre. When it begins at the centre it is termed blistering. It is due to an error in the manufacture of the plate, but is much aggravated by a developer strong in ammonia, by the use of warm solutions, by the use of too strong a fixing bath, or by the use of very soft water for washing. When it makes its appearance only in the fixing bath or during washing, it may be prevented with certainty by placing the plate, immediately after development, in a saturated solution of alum for five minutes. This we advise in all cases; but where there is no fear of frilling, the plate should be thoroughly rinsed before it is placed in the alum solution.

If the frilling be of so aggravated a form as to show itself during development, it is more difficult to prevent its occurrence. Captain Abney states that coating the plates with plain collodion before development is a perfect cure. The addition of twenty per cent. of alcohol to the developing solution will generally stop frilling, but the time taken for development will be greatly protracted.

Plates which, when newly prepared, frill, frequently, after keeping for some weeks or months in a dry place, show no tendency to the defect. In fact, we have found that the keeping of the gelatine plates for some time improves them in every way.

Want of density or flatness of image is usually due to under-development, or to the use of too weak a developer, and very frequently to over-exposure, combined with one of these. A consideration of our remarks in the last chapter on development will show how sufficient density may be gained in almost any case; and we may here say that a very common cause of want of vigour is to be found in the fact that the ammonia is not so strong as is supposed. In the case of liquid ammonia of specific gravity $\cdot 880$ a very short exposure to the air weakens it, by allowing ammonia gas to escape. It will be generally found that the last of the ammonia in a bottle is considerably below the standard strength, simply from the escape of the gas every time the bottle is opened. It is for this reason that we recommended the dilution of the ammonia with an equal bulk of water immediately after purchasing it. Pouring the strongest ammonia from one bottle to another will perceptibly weaken it.

There are some plates which will not give a vigorous negative, however they be developed. This is the case with plates on which the emulsion has been too thinly spread. If such plates are to be used at all, an after-process of intensification must be resorted to. It will occasionally happen, too, with the best of plates, that an error of judgment will be made in development, and the process stopped before density is sufficient. This is another case for intensification. We shall treat of intensification in a separate chapter.

Too great density of image is a fault sometimes met with. It is always due to error of judgment in development. It may be corrected by performing the first part

of the process for intensification, afterwards described. This method is objectionable, however, as the results may not be permanent. A better plan is to immerse the negative, after fixing and washing, in a solution of one part of eau-de-javelle to three or four parts of water. After the desired amount of reduction has taken place, the plate should be again fixed and washed.

Spots of various kinds are liable to be found in the finished negative. They are of various forms, and are produced in various ways. Minute transparent spots or pinholes are caused by dust on the plate during exposure. The plate should be brushed with a broad camel's-hair brush before it is placed in the slide.

Small transparent spots with irregular outlines are due to defect in the manufacture of the plate, and cannot be corrected by after-manipulation.

Small transparent perfectly circular spots, with well-defined outlines, are due to air-bubbles in the developer, and are only produced when too small a quantity of developer is used. Air-bubbles do not, as is commonly supposed, form on the surface of the plate under the surface of the developer; they form on the surface of the developer, and, if there is too little solution, come in contact with the surface of the plate, and there adhere.

Opaque spots are nearly always due to defects in the plates, and cannot be corrected by after-manipulation. They may occasionally arise from foreign matter in the developer.

A yellow veil, or, rather, a yellow stain, in the shadows of a negative is often found after pyrogallie development, especially if the process has been very prolonged, or if much ammonia has been used. Plates vary enormously in their liability to this defect. With most it will not occur if our instructions be carefully followed; but, if it do, it may be removed by placing

the negative, after fixing and washing, in the following solution :—

Saturated solution of alum	...	10 ounces
Hydrochloric acid	... ..	$\frac{1}{2}$ ounce

Mr. Herbert Berkeley has recently introduced a new developer, which totally prevents any yellow stains from occurring, and which deserves strong recommendation. The pyrogallic stock solution is mixed with four grains of neutral sulphite of soda to each grain of pyrogallic. The whole is rendered slightly acid with citric acid, for it must be understood that so-called “neutral” sulphite of soda is really alkaline. Care must be taken to use the *sulphite*, not the *sulphate*.

A *yellow fog* occasionally occurs, and must not be confused with the *stain* described. It is, in fact, a variety of the colour fogs of which the green and red are the commonest, and is to be treated as such. It is to be distinguished from the stain by the fact that it is yellow only by reflected light, whilst the stain is yellow only by transmitted light.

Unequal thickness of film is sometimes found in commercial plates. It arises from careless coating of the glass, and is, of course, incurable by after-treatment. The negative resulting from a plate more thinly coated at one place than at another *may* be lacking in density at the thin place; but it should be borne in mind that it need not certainly be so. Plates are generally coated with films considerably thicker than is absolutely necessary, and, in the case of a plate unequally coated, the thinnest part may contain enough of the silver salt to give the necessary density. Plates should, therefore, be tried before being condemned for unequal coating.

Various *streaks*, *scratches*, &c., occur in gelatine plates, and are evidently due to defect in manufacture. They call for no particular remark.

A *white powdery deposit* is sometimes found on the

surface of the negative after drying, especially after ferrous-oxalate development. It is, in such a case, caused by lime in the washing water. It may be removed by dipping the negative in a 1 per cent. solution of hydrochloric acid. If the solution of alum used before fixing be acid, and the negative be not sufficiently washed between the alum and the fixing-bath, a deposit of sulphur will form in a fine powder. This may be removed by gently rubbing the face of the negative with a plug of cotton-wool while water is running on it from the tap.

Irregular action of the developer, causing zig-zag lines across the plate, may occur if the developer has not been made to flow over the plate in one wave at first.

Halation is caused chiefly by reflection from the back of the plate. It makes itself evident only when the subject includes very strong contrasts; for example, when an interior with windows open to the sky is photographed, it shows itself in the form of a halo round the highest lights, and produces a very unpleasant effect, sometimes known as blurring. It occurs only to a small extent with plates that are very thickly coated. In the case of an attempt being made to photograph a very trying subject, such as the interior mentioned, it is well to "back" the plate; that is, to paint or otherwise cover it at the back with some substance which will absorb light. The following is a good method to adopt. Procure a piece of black carbon tissue, cut out a piece slightly smaller than the size of the plate to be used (there should be about $\frac{1}{8}$ of an inch margin all round), moisten the black surface of the carbon tissue with glycerine, allow all that will to drain off, and press the tissue against the back of the glass. It will adhere, and may be removed just before development.

Solarisation or reversal of the image is a curious phenomenon which may be brought about in any gela-

tine plate. It consists in a reversed action of light, or, rather, a reversed action of the developer, produced by excessive action of light. It is found that if light, beyond a certain amount, be allowed to act on a sensitive film, *less* instead of greater density occurs after development by the increase. This peculiar action does not, as a rule, give rise to practical inconvenience, but if, for example, the sun be included in a photograph, it will usually be found to be represented by a *transparent* spot on the negative, and, consequently, by a *black* spot in the print. Tendency to reversal is much greater in some plates than in others. It is reduced by increase of bromide in the developer.

CHAPTER XIII.

INTENSIFICATION OF THE NEGATIVE— VARNISHING.

At the end of the last chapter we described the conditions which give rise to the occasional necessity for intensifying a negative. The term almost explains itself. It means the increasing of the density of a negative. A good intensifier will increase the density of every part of a negative proportionately; that is to say, when there is, after fixing, clear glass in the shadows, no darkening will take place, but every grade of density, from the finest detail to the densest high-light, will be increased in a proportionate degree. The process ought to be thoroughly at the command of the operator, who should be able to produce any desired increase of density.

We may say at once that there is no thoroughly satisfactory intensifier for gelatine negatives, and that such a thing is a great desideratum. It is not within our province to enter into the discussion as to which is the best of the various more or less imperfect methods which have from time to time been published, but we shall give a formula which has, at any rate, the advantage of simplicity, and which will be found to

give fairly good results. It is one of the "mercury" intensifiers. It has two drawbacks: first, the results are not always permanent; second, there is great difficulty in regulating the amount of intensification given by it.

The first objection is much lessened, however, from the fact—not, we believe, generally known—that when a mercury intensified negative fades, it can generally be brought back to its original condition by performing again the process of intensification. We shall suppose that a negative, on printing, is found to give a poor-looking print, lacking contrast. Let the following solution be prepared:—

Bichloride of mercury	...	...	1 ounce
Water	...	...	10 ounces

The whole of the bichloride of mercury will not dissolve, but the residue may be left in the bottle, and, as the solution gets low through unavoidable waste, water may be added.

The negative is very thoroughly washed. It is placed in a dish, and the mercury solution is poured over it. It will gradually become whitened or bleached. When the film is bleached throughout—as indicated by its being white at the back—the solution is poured back into the bottle, and the negative is most thoroughly washed. On the thoroughness of this washing seems to depend to a great degree the permanency of the results.

The negative has now to be treated with ammonia solution, which will blacken it, but the strength of the ammonia solution must be varied according to the amount of density required. Thus, if the print got from the negative previous to treating with mercury was very nearly up to the mark, a very weak solution of ammonia must be used; one or two drops to the ounce of water will be enough. This solution is poured over the nega-

tive, and it will be seen gradually to darken. When all action ceases, the process is complete. The negative will now be of a curious orange tinge by transmitted light. If, on the other hand, the negative was one giving a very shadowy print, a solution of ammonia of one to twenty may be used.* On this being poured over the plate, darkening will take place almost instantly, and the result will be a fine black-coloured negative.

It is advisable to take a trial print from every negative before the process of varnishing is performed, and, in fact, if ready sensitized paper, which is always quite dry, be used, varnishing is not absolutely necessary. It is very advisable, however, and we shall describe the process before entering on the subject of printing.

After the negative is thoroughly washed and quite dry, it is taken by that corner which, were it a printed page, would be the left-hand bottom corner. It is warmed gently over a gas-burner till it feels just warm enough to be pleasant to the touch. If a gas-burner fixed above the level of the operator's head be used, a good criterion of the proper temperature is gained by watching the moisture which condenses on the plate from the water formed by the gas flame. When the moisture at first condensed is dispersed, and no more will condense on a plate, it is just at the right temperature. The plate is now held level by the corner mentioned between the finger and thumb of the left hand, whilst the varnish bottle is held in the right hand. A large pool of varnish is gently poured on to the centre of the plate. This pool should cover about half of the area of the glass. The plate is gently "tipped," so as to cause the varnish to flow first to one corner and then to another, beginning at that opposite to the one by which it is held. When the varnish comes round to the bottom right-hand corner, the plate is tipped slowly up to a vertical position, so that

all the excess of varnish may flow back into the bottle. The plate must be rocked from side to side during this part of the process, to prevent the formation of crapey lines. When all the excess of varnish has flowed off, the plate must be again warmed—this time till it is about as hot as the hand can bear. When it is cold it is ready to be printed from. There is a vast difference between plates as to the ease with which the varnish will flow over them. The process is one which should in no case be performed over a choice carpet.

CHAPTER XIV.

PRINTING AND TONING WITH READY SENSITIZED PAPER.

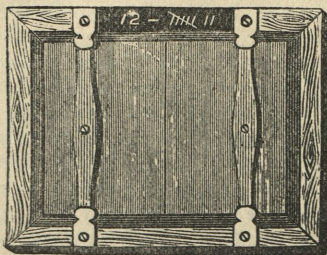
THE photographer who has followed our instructions to the present point will so far have produced only means to an end; the end itself will be nowhere visible. He has made the materials for a picture, but the picture has still to be constructed from these materials. However delightful a negative may be to the photographer as containing infinite possibilities, it is to the common eye by no means a thing of beauty. Every shade is, as we explained, reversed; before a natural effect can be produced, these shades must be re-reversed, so as to represent those of nature. This is commonly done by resorting to the process of printing. This process consists in the placing in contact with the negative a sensitive film usually supported on paper, and allowing light to act on it through the negative—the effect being, as a little consideration will show, a reversal of all shades.

There are many printing processes, all of which may be studied with advantage by the amateur. Each one has certain advantages, and some are especially suited for certain purposes; but the process which, on the whole, has held its own against all others, and which, for general purposes, seems not likely to be soon superseded,

is that known as "silver printing on albumenized paper." We propose to describe this and one other printing process, and to leave our readers to refer to more advanced or more special treatises for instructions in the various other processes.

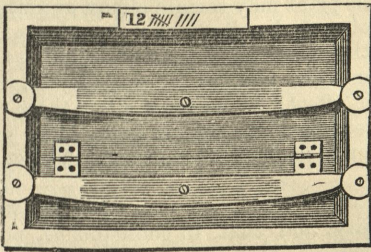
"Ready sensitized" albumenized paper is now an article of commerce, and its convenience is so great that we recommend its adoption by the beginner, and shall here describe the manipulation of such paper before we give instructions in the sensitizing of paper for immediate use. When the photographer has thoroughly mastered the process of printing, he will probably find that he can gain a higher degree of excellence by sensitizing his own paper; but certainly at first the contrary will be the case.

In printing with albumenized paper a printing-frame



is used. This apparatus is of various forms, but all these forms have the same object. They keep the paper in close contact with the negative, and are so constructed that one-half of the print can be examined at any time, whilst the other is kept in contact with the negative to prevent it from slipping. In frames made at the present day the necessary pressure on the backs is gained by the use of springs. For small negatives, the frame is usually made exactly to fit the plate. In the case of large negatives—above whole-plate, for

example—the frame is generally made somewhat larger than the negative for which it is intended, and is fitted with plate glass, against which the negative is placed. The pressure of the springs would be liable to break a large negative were it not thus protected. In the case of large negatives it is also necessary to use a pad of felt between the paper and the back of the frame, to ensure contact. We illustrate two of the forms of printing-frames. A neat “dodge” is shown at the side



of the frame for registering the number of prints taken from any negative.

We shall suppose that our beginner has purchased a printing-frame and a certain amount of ready sensitized paper. He cuts the paper to about the size of the negative he has determined to print from. He places a piece of the paper under the negative in the frame, and lays the whole outside in a bright diffused light. It is not generally advisable to print in direct sunlight. After the operation has gone on for a short time—say five or ten minutes—the result may be ascertained by taking the frame into a weak light and examining the print, one half at a time. It must be made considerably darker than it is finally required to be. The exact amount of depth that is lost in the after-processes can only be learned by experience, but we may roughly say that it is necessary to print for about twice as long

a time as that required to give a pleasing result in the frame.

It is at this stage of proceedings that we for the first time become certain whether our negative is all that can be desired, or whether it may be improved by either reducing or increasing the density. It is necessary, to give a good result, that the darkest part of the print should be about as dark as the paper is capable of becoming. It is also necessary that the negative should have such density that whilst this takes place the high lights of the print may remain almost or quite white. If there be not such density, either one of two things must occur: either we must stop printing before the shadows are deep enough, and, as a consequence, there is no boldness of effect; or we must allow those parts which ought to remain white to get dark. The consequence is, in either case, lack of contrast. The cure is intensification.

On the other hand, we may find that we have too great density, and that, in consequence, not only the deepest shadows, but some of what ought to be only half-tone, turns as dark as the paper is capable of before the detail in the lighter parts becomes evident. It sometimes occurs in such a case, also, that the very dark parts assume a peculiar appearance known as *bronzing*. In the case of an over dense negative, one of two things occurs: we have large masses of shadow printed so dark that all detail is lost, or we have large masses of light in which detail has not made its appearance. The remedy is reduction of density.

Sometimes, however, we find that we have a state of things not quite so bad as we have described, but that a negative shows indications of being a very little too dense or too thin. In this case it is a pity to resort to either intensification or reduction of density, as these processes are neither of them very completely under control. In such a case we may proceed as follows:—

We clean thoroughly the back of the negative, and varnish it *cold*. After a time the varnish will set with a "matt" surface; that is, with a surface like ground glass. We now take it, and if the density be too great, we scrape away the varnish from the *densest parts*, using a penknife; if the density be too little, we scrape it away from the *transparent parts*. This will make a sensible difference in the resulting print, but if it still lacks something, we may mark on the matt varnish with a pencil, in the case of too great density shading over the transparent portions, in the case of too little over the densest parts. A negative thus dodged may never be printed in direct sunlight.

It is to be noted that even without intensifying or dodging in any way, a slight amount of compensation for too great or too slight density may be gained simply by selecting a suitable light for printing in. Thus, if a negative be slightly too dense, a better result will be gained by printing in very bright sunlight than in the shade. If, on the other hand, it be slightly too thin, the best result is obtained by printing in a feeble light. The extent to which over and under density can in this manner be compensated for is but slight. We believe that the difference of result to be gained by printing in light more or less bright has been greatly exaggerated by most who have written on the subject.

When the desired number of proofs have been printed, the paper should be trimmed to the correct size. This is generally done with scissors, using "cutting moulds," or thick plates of glass, which can be had of any size. Many prefer to trim their prints after they have gone through the various processes of toning, fixing, and washing; but there are several advantages in trimming before toning. The clippings, if kept, become, when a large quantity has accumulated, of value; there is a saving of toning solutions, and the trimming is far easier to do before washing, as the paper lies flat; whereas,

afterwards, it curls up in a way which makes it difficult to manipulate. The following solution is prepared for toning :—

Chloride of gold	...	...	15 grains
Acetate of soda	...	...	1 ounce
Water	...	...	15 ounces

The chloride of gold is purchased in small sealed tubes holding fifteen or thirty grains each. One of these tubes is placed in a bottle capable of holding the whole solution; when there, it is broken by striking it with a glass rod, due care being taken not to break the bottle, which is quite possible. The acetate of soda is then added, and the water being poured in, the whole is shaken till the acetate dissolves. The solutions must be kept at least twenty-four hours before being used, and must not be exposed to a strong light. It should be labelled, "*Toning Solution, One Grain to the Ounce.*" The other solution which is required is one of two ounces of hyposulphite of soda to each pint of water, and should be labelled "*Fixing Solution for Prints.*"

It will be noticed that the prints as they come from the frames are of a more or less unpleasant colour. The operation which is to be described, and which is called toning, is intended to correct this defect, and to give them the pleasing colour which we are accustomed to see. The process consists in covering the image with an exceedingly thin film of gold.

Toning may be said to be at once the easiest and the most difficult of photographic processes. Nothing is easier than to *tone*, nothing more difficult than to *tone well*. Anyone can change the colour of a print to a sort of slatey grey; there are not very many who can be sure of getting at all times a pleasing tone and the exact tint required. The difficulty lies in the direction so common in photographic operations. A certain result is gained, but the after processes modify this result, so

that great experience is necessary to know beforehand what will be the final appearance of the subject.

We shall describe as exactly as possible the operations, and for the rest, as in so many cases, the beginner must look to intelligence and experience for success.

The toning solution mentioned in the first part of our lesson is too concentrated to use as it is; it must, therefore, be diluted. The common practice is to use a large quantity of toning solution, and, if it is not exhausted, to keep it for after-use. This is very well for the professional, who tones at regular intervals, but in the case of the amateur we think it is not advisable. The solution once used is very liable to "go bad," the gold being deposited at the bottom of the bottle. We therefore recommend that the beginner estimate the amount of toning solution that will be necessary, allowing a little margin, and that after he has used it once, he throw it away. The waste will be very small—so small that it will not be found worth while to keep the liquid as residue. If the prints be trimmed before toning, one grain of gold is amply sufficient for each sheet of paper measuring 17 inches by 22 inches. One ounce of the stock toning solution is, therefore, taken for every sheet of paper, and is diluted with twelve or fourteen times its amount of water.

The prints are now taken one by one, and placed, face downwards, in any dish which is suitable for washing them in; a common small wooden tub is the best of all. They must be kept from sticking to each other, and be moved about by hand. It will be seen that the water becomes milky from the nitrate of silver in the paper forming chloride and carbonate of silver with the salts in the washing water. The water must be changed several times till this milkiness disappears entirely, or almost so. Now the prints are ready for toning. The washing is best done by the light of a candle or lamp, as such will not affect the paper. The toning must be done in

feeble white light, as it is difficult to judge of colours by yellow light. It is best performed in a flat white dish at least an inch larger each way than the prints.

One print is taken from the washing water, and placed in the toning, first face downwards, then turned face up, then down, once or twice, so as to allow the solution to act evenly on it. Now another print, and perhaps two or three more, are similarly placed in the solution. It will be noticed that the prints, during washing, turn to a brick red. In the toning they will turn to a brown, and gradually to a sort of violet or purple. They must be kept in constant motion. The best plan is to keep continually lifting the undermost print, and placing it on the top. At first, only a few prints should be attempted; after some practice, a dozen or two may be in the solution at once. When many prints are toned together, it is a good plan to have two dishes of toning, side by side, and keep lifting the prints out of one into the other, the whole of the prints being turned over in a mass when they are all in one dish.

The difficulty is the one indicated before—viz., at the time of toning to discount the change which will take place during the after processes. The difficulty is greatly increased by the fact that every brand of paper acts in a somewhat different manner from any other. Very few ready sensitized papers will stand being pushed to the purple stage; that is to say, if the toning is continued to the purple, the final result will be disappointing, although the prints may look beautiful before fixing. It is usually advisable to remove the prints from the toning solution whilst they are still of a very warm brown in the shadows. It is a good test to watch the half-tones, and when these begin to become purple or violet, to remove the print. The prints, when removed from the toning solution, are placed in another dish of clean water. They must be moved about for a short time after first placing them here, so

as to get rid of the greater part of the toning solution which is in the pores of the paper, and which would make the toning proceed after it is desired to stop it. When all the prints have passed through the toning bath they must be washed in several changes of water, being kept moving for about five minutes during each change. Now comes the fixing. The prints are removed from the washing water, and are placed in a flat dish. Sufficient fixing solution to quite cover the prints is poured in, and they are kept moving for about twenty minutes. More than one change of colour will be noticed during this time. The first will be an almost total loss of tone; afterwards the colour will return to something like its former self. A further change will take place when the prints are dried. After fixing, it is necessary to wash the prints most thoroughly for not less than twenty-four hours. This is best done in running water; but if this cannot be had, then frequent changes will do. The smallest trace of hyposulphite in the prints will cause them to fade.

The thing most necessary to observe during all these operations is, that the prints be at no time allowed to stick together in a mass. If such occur at any stage, prints of a disagreeable colour, with yellow or degraded whites, are sure to result.

The prints, after washing, are allowed to dry spontaneously, being placed on any clean surface; or they may be mounted wet on cardboard. In either case they should be afterwards rolled. A rolling-press is an expensive article; but the amateur can generally find some neighbouring photographer who will roll his prints for a small consideration.

CHAPTER XV.

SENSITIZING ALBUMENIZED PAPER—THE PLATINUM PROCESS.

THE great convenience of ready-sensitized paper is, that it will keep for a very considerable time, either before printing, or between printing and toning. The means of preparing such paper is at present a trade secret, and when the amateur prepares his own paper, he will find that it will turn brown after about twenty-four hours. He must therefore do his sensitizing and fixing all in one day. If he has time to do this, he will probably be rewarded by superior results. We shall therefore describe the process of sensitizing.

“Salted” albumenized paper is purchased—that is to say, paper coated with albumen which is impregnated with soluble chlorides.

A “silver bath” is prepared by dissolving nitrate of silver in distilled water. The strength of the bath varies with the paper used. Every dealer in albumenized paper will state what strength of bath is best to use for the particular brand. One containing sixty grains of nitrate of silver to each ounce of solution will suit most papers. Enough of this must be prepared to cover the bottom of the flat dish to be used in sensitiz-

ing to a depth of at least $\frac{1}{8}$ -inch. The dish should be half an inch larger than the paper in each direction. If much paper is to be used, it is best to sensitize in large pieces, and cut it into sizes before printing. Professional photographers usually sensitize a whole sheet at a time.

A room lighted by a lamp or gas is the best to carry on the sensitizing process. Strings should be stretched in convenient position for hanging the paper on to dry. American clips are useful for fixing the paper to the strings.

The silver solution is poured into the bath, and a piece of the paper is taken by opposite corners, and with the albumenized side downwards. The paper is so held that it will first touch the surface of the solution in a line between the two corners not held by the hands. We again take the simile of a printed sheet. Suppose the paper held by the right-hand upper and left-hand lower corners. The left-hand upper corner is allowed to touch the surface of the solution, and the paper is lowered till it touches in a line from the left-hand upper to the right-hand lower corners. Now the two corners held in the hands are dropped first one and then the other. This sounds elaborate, but it is very simple in practice. If it be carried out properly, there should be no air-bells under the paper, but it is best to lift it from the solution after about a minute, and look to make sure. If there are any, they can be broken by gently moving about the paper whilst one-half is held out of the solution.

The time of floating varies with different papers and different strengths of baths. It should be ascertained when the paper is purchased. With a 60-grain bath from three to five minutes is usually ample. If the paper curls away from the solution at the edges, it may be caused to lie flat by blowing on it.

After the specified time has elapsed, the paper is taken up by two adjacent corners and withdrawn from

the surface of the solution very slowly, so that it drains as it is being lifted. It is only necessary now to hang it up by one corner to dry. A small fragment of blotting-paper should be caused to touch the lower corner immediately after it is hung up. This will adhere by capillary attraction, and collect a drop or two of solution which would otherwise fall on the floor.

If the room be warm, the paper will dry in ten minutes or a quarter-of-an-hour.

When it is dry, printing, toning, &c., are performed as described for ready-sensitized paper. Good albumenized paper, sensitized as described, may be toned to a far deeper purple than the paper purchased ready sensitized.

The silver solution becomes weaker through use, and it is necessary to strengthen it at intervals. Its strength can be ascertained by the use of an "argentometer," which is a cheap form of hydrometer specially graduated for grains of silver per ounce of solution.

It is the custom with some operators to "fume" their sensitized paper. They claim that a more brilliant result is thereby gained, and that toning is more readily performed. This is so, at any rate, in the case of certain brands of paper. The process consists simply in exposing the paper to the fumes of ammonia. With those who print on a large scale, a special box, in which the prints are suspended on netting over liquid ammonia, is generally used; but we have been able to succeed very well with a makeshift apparatus. We shall describe this, and the methods which we have found to give very satisfactory results.

After the paper is sensitized and dried, it will be found to curl up badly, but may be straightened by drawing it, face downwards, between a pad of blotting-paper and a paper-knife with a blunt edge.

A box of any kind, measuring a couple of feet or so in length and breadth, and (say) a foot deep, is taken.

One of those millboard contrivances used by dress-makers in which to pack the finery worn by the superior sex will do very well. A small portion of the stock solution, consisting of one part strong liquid ammonia and one part water, is sprinkled over the bottom of the box. The bottom being then covered to a depth of several inches with crumpled paper, the sensitized paper is placed on this, and the lid is shut down. After things have remained so for a quarter-of-an-hour, the paper will be fumed.

Fumed paper prints somewhat more quickly than that which is not so treated.

We have said that silver printing appears still to hold its own against all rivals, and to remain the most popular process. It is, however, by several of these hard run, and, perhaps, by none so hard as by the process known as the Platinotype. This, although of comparatively recent date as a commercial printing process, has nevertheless become a great favourite, and appears to be ever gaining in the estimation of the public. This it does, certainly not without reason, for to our way of thinking it is the most attractive of all printing processes. It has several very great advantages over the silver process. Firstly and chiefly, the results are permanent; secondly, the results are, to an artistic eye, far more pleasing than those of silver printing—the colour is an engraving black, and the surface is not glazed, but matt, like drawing paper; thirdly, the process is far more easy to work. The time taken for printing is not quite half what is necessary for albumenized paper. There is no toning, nor is there any prolonged washing.

It may be asked why, if there are so many advantages in the process, it does not at once supersede silver? We can only say that it is rapidly gaining in favour, and may do so, but that, as in every case where there are advantages, there are certain disadvantages also.

In the case of the platinotype process, that of *price* certainly is one. The expense of producing a platinum print is considerably in excess of that of making a silver print. Then, again, public taste has not yet been educated to thoroughly appreciate the beautiful delicacy of the colour of a platinum print. Possibly, this is so much the worse for the public, but it is, nevertheless, the fact. Farther, a good negative is necessary to get a good platinum print. The same is the case, no doubt, with silver, but with a thin and miserable negative, something more passable may be had in silver than in platinum. One other deterrent is no doubt to be found in the fact that the process is a patent, and that a sum—certainly trifling—has to be paid for a licence.

All the appliances for platinum printing are to be had from the Platinotype Company, 26, Southampton Row, High Holborn, London, W.C., and with them instructions for working, so full and concise, are issued, that we need only briefly describe the process. The one thing which requires great and constant attention is the keeping the paper thoroughly dry. It has to be kept in a metal case with a small quantity of calcium chloride, when not actually in the frames, and when in these, it is necessary to keep a thin sheet of india-rubber behind it.

Printing is performed in the usual way, but the image which appears is not brown, or purple, but is of a faint greyish brown colour. This at first is puzzling, but one soon learns to judge of the exposure as accurately as with silver. The prints have to be developed by floating them on the surface of a hot solution of water, containing 130 grains of oxalate of potash to each ounce. A flat iron dish is the best to operate with. The solution is kept at a temperature of 170 to 180 Fahr., by means of a spirit lamp or

Bunsen burner. The process of development is a most beautiful one. The print, before it is developed, is only just visible. It is placed thus on the surface of the solution, and in a few seconds there is removed a picture most perfect in colour and gradation of tone.

The developed print is transferred to a dish containing one part of hydrochloric acid in sixty parts of water. Hence it passes to a second, and then to a third, similar bath, remaining a few minutes in each.

It is then washed for about a quarter of a hour in several changes of water, after which it is finished. Negatives which are just somewhat too dense for silver printing give excellent results with platinum. Any negative, however, which will give a good silver print, will give a good platinum print.

CHAPTER XVI.

MANUFACTURE OF GELATINE EMULSION.

WE gave it as our opinion, when commencing these lessons, that the amateur will generally find it best to purchase plates from the manufacturer. He will probably find it both cheaper and more satisfactory to do so than to manufacture them himself, unless he has at his disposal considerable time, and has great patience and a happy temperament, which will enable him to bear frequent disappointment, when, after going through the tedious process of making an emulsion and coating the plates, he finds that the latter are, from some unknown cause, useless.

Nevertheless, we believe that the photographer who makes himself acquainted with the process of the manufacture of dry plates, and knows how to make an emulsion, will have a more thorough mastery of the working of them than those who have never made their own plates. There are some few who, for the love of the work, prefer to make their own emulsion. These are the real enthusiasts to whom we look to further our knowledge of photography, and with such the manufacture of plates pays, if it be only in the satisfaction they have in relying on themselves alone.

The subject of gelatine emulsions and plates is one

on which volumes might be—and, in fact, have been—written, and here, of course, we can but give the briefest instructions. If the photographer succeeds with these, he may with advantage take up the study of the advanced works which have been written on the subject.

We first give a formula and instructions whereby a slow emulsion of very high quality may be made. The plates prepared from it are very well suited for landscape work, where great rapidity is no object. They will be found to require exposures from five to eight times those given in the tables, pages 65, 66, and 67. We afterwards give instructions for the making of emulsions of the very highest sensitiveness.

The principal piece of apparatus required is a drying cupboard or box. This we illustrate and describe in the next chapter.

The other apparatus necessary is as follows :—

A large slab of plate glass, marble, or smoothed slate, levelled accurately, so that the plates can be laid on it to set. The larger the slab the better, as more plates can be placed on it at once.

A piece of coarse canvas or “scrim,” such as ladies do worsted work on—say two feet square.

Several glass beakers or jars for mixing solutions in. Jam-pots are suitable, and are better than glass vessels, as the latter are very likely to be broken in the dark room. The best of all, however, are glazed earthenware pots, known as “shut-over jars.” These have lids with a lip, which close light-tight, and are therefore most convenient for dark room manipulations. Three or four holding half a pint, and two or three holding a pint, may, with advantage, be purchased. They, as well as various other stoneware vessels useful in photographic work, are to be had of Messrs. James Stiff and Sons, High Street, Lambeth, London, S.E.

An ordinary hair-sieve, say six or seven inches diameter.

A vessel of such a size and shape that the sieve may stand in it, and that when it—the vessel—is full of water, the upper edge of the sieve will stand (say) half-an-inch above the surface of the water.

A large glass filtering funnel.

Several hock bottles. These, from their deep red colour, are useful for performing the various manipulations in.

An ordinary saucepan.

A Bunsen ring burner, on which this may stand to boil.

The following solutions are prepared, and each is mixed in one of the stoneware vessels.

A

Nitrate of silver	...	...	200 grains
Distilled water	...	...	4 ounces

B

Bromide of potassium	...	...	155 grains
Nelson's No. 1 gelatine	...	...	40 „
Distilled water	...	...	4 ounces
A one per cent. mixture of			
hydrochloric acid and			
water	...	...	100 minims

C

Iodide of potassium...	...	...	12 grains
Distilled water	...	...	$\frac{1}{2}$ ounce

D

Hard gelatine, such as that			
sold by the Autotype Com-			
pany for dry plates, or that			
known as Heinrich's	...	...	240 grains
Water	...	...	several ounces

B and D are allowed to stand till the gelatine is thoroughly soaked, as indicated by its being quite soft.

All the water is now poured off D, and as much water as possible is squeezed out of the gelatine.

The pots containing A and B must now be placed in hot water till the solutions are at about 120° Fahr., when B is poured into one of the hock bottles.

From this time all operations must be performed in the most feeble ruby light possible.

A little of A is now added to the solution already in the bottle, and the whole shaken. Small additions of A are made so that it is poured in five or six stages into B, the whole being shaken at each addition, and a very thorough agitation being given at the end.

C is added, and the solutions, now forming an emulsion, are again shaken.

The whole is poured into one of the stoneware pots. This is placed in the saucepan, the lid is placed on the latter, and the water brought as rapidly as possible to the boil. A loose cover of some sort should be placed over the vessel during this part of the process, if an otherwise open one has been used, to prevent condensed water from dropping off the lid of the saucepan into the emulsion. The emulsion is allowed to remain for half-an-hour in the boiling water.

At the end of the half-hour the gelatine D is placed among the emulsion, and the whole stirred to mix it. The pot is then put in a cool and dark place to allow the emulsion to set. It will do so in from one to two hours on a moderately cool day; but it may be left for days if it be desired. This is the best period at which to break the process, which is somewhat lengthy to be performed at one time.

When the emulsion is set quite stiff, or as soon afterwards as it is desired to complete the process, it is removed from the vessel either with a silver spoon or a strip of glass. The sieve must meantime have been placed in its appropriate vessel full of water. The lump of emulsion is placed in the canvas, the whole

is placed under water in the sieve, and the canvas is twisted up so as cause the emulsion to pass through it in fine shreds into the water. It must now be washed for half-an-hour, either by allowing water to run into the sieve, or by frequently changing the water in the vessel. The object of this washing is to get rid of the soluble nitrates and bromide, whilst the insoluble bromide and iodide of silver—the sensitive salts—remain in the emulsion. At the end of half-an-hour the sieve may be removed from the washing vessel, and be placed in any convenient position, with one side somewhat tipped up, so that all superfluous water will drain off. The draining should go on for at least half-an-hour. At the end of that time the emulsion is finished, and only requires to be re-melted and filtered. We have found nothing better for this than several folds of cotton—such as pocket handkerchiefs are made of.

Three-quarters of an ounce of alcohol is now added, and the emulsion is ready to be used for coating the plates. The quantity will be about twelve or fourteen ounces. It may be kept in one of the hock bottles, wrapped in brown paper.

For an exceedingly rapid emulsion, the following formula may be taken:—

A

Nitrate of silver ...	...	...	200 grains
Distilled water ...	...	...	4 ounces

B

Bromide of potassium ...	...	...	155 grains
Nelson's No 1 gelatine ....	...	...	30 „
Distilled water ...	...	...	4 ounces

C

Iodide of potassium ...	...	...	6 grains
Distilled water ...	...	...	$\frac{1}{3}$ ounce

D

Hard gelatine, such as that sold by
 the Autotype Company for dry
 plates, or that known as Heinrich's 250 grains
 Water several ounces

One of the matters requiring the nicest attention now comes to be done. This is to render the solution B the least bit acid. It must be only perceptibly acid. In fact, it is probable that absolute neutrality, were such attainable, would be the best condition. Alkalinity is dangerous to the quality of the emulsion. Too great acidity is detrimental to rapidity. Very often the salts are themselves acid. Occasionally they are alkaline. They must be carefully tested. The silver solution (A) should not change the colour of either blue or red litmus paper. The bromide solution (B) should slowly turn blue litmus slightly red. It should be rendered sufficiently acid to do so by the careful addition of very dilute hydrochloric acid. If the silver (A) solution be perceptible, or the bromide solution (B) be more than only perceptibly acid, the excess of acidity may be neutralized by the addition of very dilute liquor ammonia.

The operations after this are the same as for the slow emulsion up till the time of boiling. It is usual, in giving instructions for the manufacture of a rapid emulsion, to say how long boiling should be continued; but there are such extraordinary differences of experience in the matter, that we avoid such a course. Some operators gain sensitiveness in a half or a third of the time which others take, apparently working under precisely similar conditions. We advise experimenters to have recourse to the colour test which we explain.

If, immediately after emulsification or the mixing of the chemicals, we take from the vessel with a glass rod a drop of the emulsion, place it on a piece of

clean glass, and look at a light, such as a candle or gas flame, through it, the glass being held somewhat near the eye, the flame will appear ruby, or, at any rate, orange. The emulsions are said to be "orange by transmitted light." If we examine it after (say) an hour's boiling, there will appear a very distinct change of colour. There will be a more or less near approach to blue in the appearance of the flame, and the emulsion is said to be more or less nearly "blue by transmitted light."

In practice, the emulsion is stirred (say) every quarter of an hour during boiling, and a drop of the emulsion is examined as described. When the change from red to blue is quite complete, the emulsion will have reached a high degree of sensitiveness. The exposures required for plates coated with it will be as near as possible those given in the tables, pages 65, 66, and 67. The process may be pushed still further, however, until an emulsion, giving plates which will require exposures of only one-half to one-third of these is obtained. If such be attempted, however, the very utmost care must be exerted at every turning, as this very sensitive emulsion is most ticklish to work with. To make it, boiling is continued for a period altogether twice as long as that required to bring about conversion of the bromide to the blue variety. In the writer's practice, it takes an hour and a half or thereby, as a rule, to get the blue colour, and he has boiled for as long as six hours without spoiling the emulsion. After boiling is complete, the process is the same as for the slow emulsion.

CHAPTER XVII.

PREPARING GLASS: COATING IT.—DRYING AND PACKING PLATES.

To prepare plates for coating, it is necessary, if they have been used before, to remove the old film; and whether they have been used or not, to polish them on one side to receive the emulsion.

To remove old films, the plates are left to soak for at least twenty-four hours in a mixture of one part of hydrochloric acid to twenty parts of water. Any waste acid will do. The strength of the mixture is not important, so long as it is not too weak, and almost any acid will do as well as hydrochloric; the same acid bath will do for a long time.

After the plates have been the time specified in the dilute acid, the films may easily be removed by the use of warm water and a scrubbing brush. Whiten-
ing is the best material to give such a polish to the glass that the emulsion will flow easily on it. A mixture of ordinary whitening and water to the consistency of a thick cream is made. This is thinly spread on one side of the glass with a cloth, all the plates to be cleaned being thus smeared, and placed against the wall or in racks to dry. When the whitening has

dried on them, each plate is taken in the hand. The greater part of the composition is removed by a *very slightly* damped cloth, and the plate is rapidly polished with a perfectly clean and dry cloth; a beautiful surface is by this means obtained.

There are several methods of coating plates in common use. The best for those who have the skill is the method used for coating with collodion, and which we describe; but we imagine most of those who have not worked the wet process, will find the plan which has been used for some time by the writer, and which is also described, the most convenient. For the ordinary method, the apparatus necessary is as follows:—

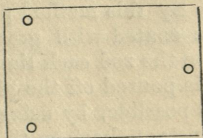
A small tea-pot. A large flat dish of the nature of a porcelain flat bath to catch spillings. A pneumatic holder; this is an india-rubber ball with sucker attached, the whole forming an apparatus whereby it is possible to pick up a plate.

In coating by the ordinary method, it is advisable to have two ruby lamps, one placed at the back of the operating table, the other in front of the operator, and above the level of his head. He can thus see the emulsion on the plate, both by reflected and by transmitted light. The flat dish is placed between the lower light and the operator; the teapot, full of emulsion, melted, and at a temperature of 120° Fahr., or thereby, may be placed on this dish, and the plates, *polished side downwards*, are placed to the right of the flat dish.

The pneumatic holder is taken in the left hand, which is stretched across the flat dish, to take hold of a plate. The plate is held level, and a pool of emulsion is poured on to it, and guided over it exactly as was described for varnishing a plate in Chapter XIII., page 85. The only difference is that more than half

the plate is at first covered with emulsion, and that, instead of the plate being drained, it is only slightly tipped up, so as to let a little of the emulsion return to the tea-pot. After this is done, the plate is gently rocked for a few seconds, till we see by looking through it that the coating has spread evenly. To tell whether the plate has had enough emulsion left on it, we look through it after it has set at one of the ruby lights. If we can see the form of the light through the film, there is not enough emulsion on the plate.

The plates, as they are coated, are placed on the levelling slab to set. Some emulsion is sure to be spilled into the flat dish. It is allowed to set, is then scraped up with a strip of glass, and re-melted. For the method of coating which we recommend to those not skilled in the wet process, the pneumatic holder is not required. It is necessary, however, to make a small tripod. This is done by gluing three somewhat large-sized shot on to a quarter-plate in the form of a triangle, thus,—



There is also needed a glass rod about two inches longer than the width of the plate to be coated, and a jam pot or glass measure in which to stand the rod. The dark-room lamp is placed within a few inches of the left hand end of the levelling shelf, and to the back of it. There is to the left of the lamp, room only for the pile of plates, which, in this case, have the polished side upwards. The rod standing in the jam pot is to the right of the lamp. The teapot with

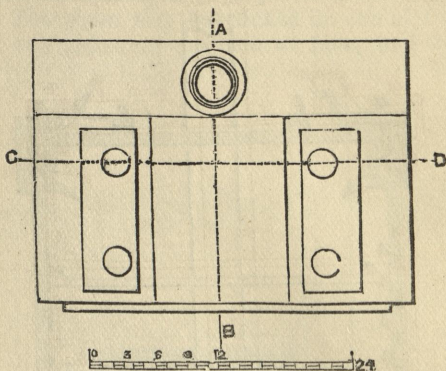
emulsion in it, as before, is in front of the lamp, and farther forward still, near the front edge of the slab, is the small tripod mentioned. A plate is taken from the pile, and placed on the tripod.

A pool of emulsion, about half covering the plate, is poured from the teapot. The glass rod is taken between the fingers and thumb of each hand, and dipped into the pool of emulsion right across the plate. The emulsion will run between the rod and the plate to each edge of the latter. By a motion of the finger and thumb of each hand, the rod is lifted the smallest possible distance from the plate, and is rapidly moved first to one end, then to the other, the tips of the finger and thumb resting on the level table as a guide. This, if properly done, will cover the whole plate with emulsion; and if the plate be small—half-plate or under—it is sufficient to slide it to the far end of the table to set. If the plate be large, the coating will not be evenly spread unless it is lifted, balanced on the tips of the fingers of the left hand, and rocked gently for a few seconds. By this method plates may, after a little practice, be coated with great rapidity. There is no need to wipe the rod each time it is used.

As no excess is poured off the plate nor spilled in this method, it is possible, by using a very small teapot, to keep a constant check on the quantity of emulsion going on to the plates. The covering power of the slow emulsion will be found somewhat greater than that of the rapid. With each ounce of the slow emulsion, 8 quarter or 4 half-plates may be coated. With the rapid, only 7 quarters or 3 halves.

The plates will “set” in a few minutes—that is to say, the emulsion will stiffen like a jelly—and will not run off the glass, whatever position it is placed in. They are now transferred to the drying-box. When dry, they are ready for use.

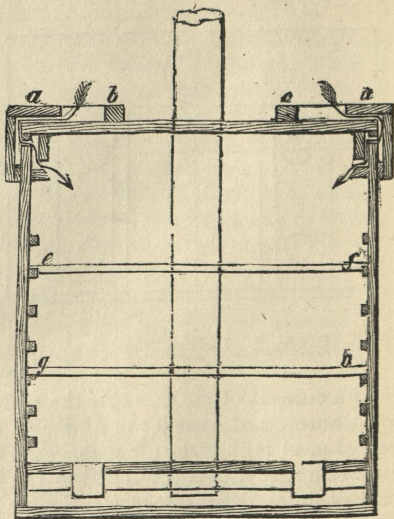
The drying-box calls for some description. There are various forms in use. They all have in view the



inducing of a current of air amongst the plates, generally by the burning of a gas jet in a tube or chimney. The fault of most is that the air passages are far too contracted. In many, heat is applied to the incoming air. This is quite unnecessary, if the air passages are sufficiently large and are well arranged, and if the box can be placed in a fairly dry place. It is, moreover, the greatest mistake to use artificial heat in drying plates, if it can possibly be avoided, as they are rendered distinctly slower thereby.

We here illustrate a form of box which has been in use by the writer for several years, and has given complete satisfaction. It will be seen that the air enters at the top of the box. It is drawn into an air chamber at its lower portion, and hence passes up the large tube with a gas flame burning in it. This tube must be carried either into the open air, or into a chimney. The plates are placed in racks, which were

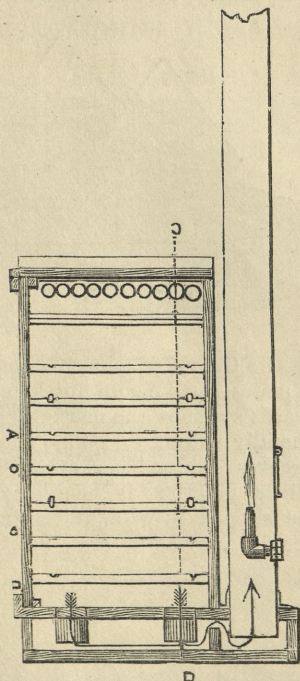
first designed by Mr. G. F. Williams. A sketch of one of these is given. Two plates may be placed back to back in each pair of notches if desired. The



racks can be placed on the cross rods shown in the box, the height of which may be adjusted to suit various sized plates. Boxes and racks as described are made by Messrs. D. Gordon Laing and Son, 2, Duke Street, Adelphi, London, W.C.

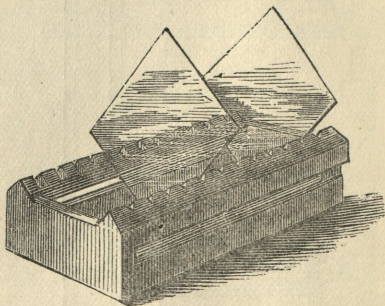
The plates will take from twelve to forty-eight hours to dry, according to circumstances. When dry, they may be used at once, or may be packed for use at any future time. No limit is as yet known to the time during which plates will keep if stored in perfectly dry pure air. They are very readily destroyed, however, by damp, gas fumes, &c.

Plates may be packed in opaque orange paper, such as is sold by most photographic dealers. The paper used for the making of "masks and discs" is the best. The plates may be packed in sets of 4 or 6. Every two plates are put face to face, and have a



piece of tissue paper between them. Three packets of 4, or two of 6, are then taken, and wrapped together in a thickness of opaque orange paper. Two wrap-

pings of brown paper are then put around all, and the package may be handled in any light. For amateurs, who never make a very large stock of plates, the best course is to use grooved light-tight boxes. Such made of wood are very expensive, but paste-board boxes, which are very handy, are made by Mr. B. J. Edwards,



of 6 and 9, The Grove, Hackney, London, for storing his own plates in. We do not know whether or not Mr. Edwards supplies the market with the boxes, but he is generally willing to oblige amateurs with a few. The grooves of these boxes are made with paper, and some little practice is necessary before the plates can be slipped in without tearing this. If a little patience be exerted at first, however, all will go well.

CHAPTER XVIII.

CONCLUDING REMARKS.

IN conclusion we have but little to say. We have endeavoured in our little book to give as clear and as practical instructions in the various manipulations connected with negative making and printing as possible. It must be understood, however, that few rules or instructions appertaining to photography are absolute ; they are all varied by circumstances. All that can be done by written instructions is to guide the intelligence of the beginner. When he ceases to be a beginner, he should depend on his own intelligence and faculty of observation more than on any instructions.

Let the student not be discouraged by failure. Failures he is certain to have. Even the most experienced fail occasionally, the majority more often than they are willing to allow ; and if they do not always succeed, it is unreasonable for the tyro to expect to do so. Nevertheless, he should aim at perfection, and should not be satisfied till he reach it. Let him remember that, at least in landscape work, no amateur need despair of reaching the highest degree of perfection. Amateurs and professionals compete continually against each other, and the former as often as not carry off the palm.

The young photographer should, from the first, exercise his faculty for observation, and note the most minute departure from received rules. There are few departments of science in which there is so wide a field for investigation as in that of photography, and even the

veriest tyro, if he observe closely, may add his mite to the mass of knowledge, which has been built up, for the most part, of such mites of observation freely given to "the brotherhood" by those who have made them. Frequently, a fact noticed by one comparatively inexperienced in photography may give the hint to a more experienced investigator, who may make good use of it.

Another thing to be impressed on photographers is that they should not fear to give others the benefit of their observations merely because it is possible that similar observations have been made before. It is sufficient that a fact is not generally known or appreciated to justify its publication, and the oftener it is published until it is appreciated, the better.

We have before remarked that, if the beginner can get the help of a photographic friend, he will find his first labours much lightened. We would now urge upon him that, whenever he begins to feel his way, he should, if possible, join one of the numerous photographic societies which there are in this country. Let him not suppose that he will meet with ridicule or contempt on account of his comparative ignorance. The writer was for some time deterred from joining a photographic society for such a reason; but on attending the first meeting, all his fears were dissipated. The terrible "professional" whom he had dreaded to meet he found to be a most kindly individual, willing—nay, apparently anxious—to give what aid he could to anyone who asked advice or assistance from him. In this respect we believe photographers are different and superior to most other professional men. An amateur architect, engineer, or doctor would by no means meet with the same kindly reception from professionals, at the gatherings of their societies, that the amateur photographer does at the gatherings of societies composed chiefly of professional photographers.

Finally, we repeat our advice, that the reader, while

he is still unfamiliar with the various manipulations, follow to the letter our instructions; but that when he begins to feel his way, he trust to his own intelligence as his great guide. If he do this, we are sure that from the time he first succeeds in producing by development *something* on his plate, till the time when he has arrived at such perfection that he need not hesitate to hang his pictures on the walls at photographic exhibitions side by side with those of the first photographers of the day, he will feel that every step in advance which he makes is a triumph, and will find his work—or play, as he likes to consider it—a more absorbing and delightful one than almost any other that he could have taken up.

Let him bear in mind that every operation is but a means to an end (the end being the picture), and that any means that conduces to the end is permissible. Let him remember, whatever may be said to the contrary, that photography is a fine art, or, at least, is capable of being such in the hands of those who have any art feeling in them. It is too common a thing to hear painting compared with photography—of course, to the discredit of the latter. This is not right. The two are, in reality, not comparable; they are different in intention and in essence. Nevertheless, photography is silently and slowly, perhaps, yet surely, influencing painting. It is teaching painters the great lesson that without truth there can be no true art. In what we now say, do not let us be misunderstood. We do not mean to say that unless some object be rendered with strict accuracy there is no art; but we mean this, that unless an object—say a tree or a man—is represented as it is *possible* for this object to be, then just in as much as it departs from this possibility it departs from true art. If a man or a horse is represented in a position that no man or horse ever was in, will be in, or could be in, then this is wrong. If a house is shown as it could not stand, or a mountain as no mountain exists,

it is wrong. In this matter painters—let them confess it or not—are being educated by photographers.

We now seldom see portraits of men and women showing proportions between feet, hands, head, and body, such as never were; but we have only to look at portraits of fifty years ago (sometimes by eminent artists) to see that at one time things were different—that almost every man was represented as a monstrosity. In landscape painting the influence of photography is not so great, but it is there, and will continue to make itself more and more felt.

On the other hand, one of the highest phases of art is that which selects and combines, which, without representing a scene exactly as it is, is careful to show it as it *might* be. The power of thus selecting and combining is one which photography has but in a limited degree.

We would fain carry our reader on to more advanced branches of the art science; we would with pleasure instruct him in various methods of producing permanent prints, besides the one which we have described, and in the delicate manipulation of vignetting and combination printing from two or more negatives; in the mysteries of enlarging, and in the thousand and one various manners in which the end—a picture—may be produced from the photographic beginning—a negative; but such is without our limits, and we recommend those who wish to go deeply into the matter to read diligently any of the several excellent and complete manuals and text-books on photography which exist.

We believe that we have filled a little gap in photographic literature—that we have produced the first set of instructions for working modern dry plates which presupposed no knowledge of any other photographic process.

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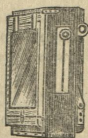
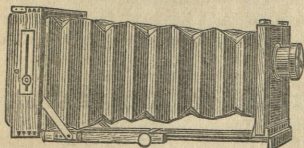
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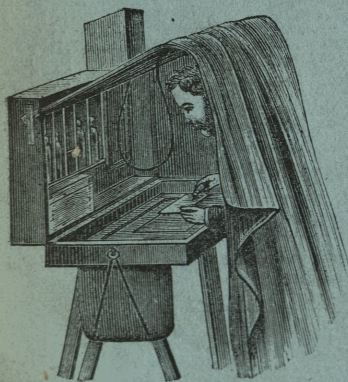
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